A star (*) indicates that the Abstract deals with Apparatus and Instruments.

AUGUST, 1938.

GENERAL PHYSICS.

ADSORPTION (see Surface Properties).

ATOMIC AND MOLECULAR STRUCTURE.

3043. Saturation Requirements for Nuclear Forces. G. Breit and E. Wigner. *Phys. Rev.* 53. *pp.* 998–1003, *June* 15, 1938.—The inequalities between the coefficients M, H, B, V, representing the proportions of Majorana, Heisenberg, Bartlett and ordinary interactions in the symmetric Hamiltonian, arising through considerations of saturation and of the instability of odd-odd nuclei heavier than N^{14} are represented graphically. The allowed values of M, H, B, V correspond to a part of a plane bounded by three straight lines. These inequalities are sufficient for saturation at infinitely high density of nuclear particles and all conditions derivable from the necessity of saturation for the potential energy in the high density condition are derivable from those listed. The limits set on the interactions in the ^3P and ^1P states by the inequalities are discussed. The results are summarised. The sufficiency of the conditions is discussed. The physical limitations are considered. AUTHORS.

3044. Stability of Nuclear Isomers. M. H. Hebb and G. E. Uhlenbeck. *Physica,* 5. *pp.* 605–608, *July,* 1938. *In English.*—It is shown that the internal conversion of γ-rays is large when the change in angular momentum in the nuclear transition is large and the change in energy small. This has two consequences for nuclear isomers: (*a*) The lifetime of the higher isomer against transition to the lower is considerably decreased compared with the lifetime against γ-radiation alone, and (*b*) the transition will usually be accompanied not by γ-radiation but by emission of a conversion electron. AUTHORS.

3045. Energy Loss of Elementary Particles with Integer Spin. E. C. G. Stueckelberg. *Helv. Phys. Acta,* 11. 4. *pp.* 378–380, 1938. *In German.*—The heavy electrons with integer spin, whose existence has been rendered probable by cosmic-ray evidence, can lose their energy, apart from ionisation and radiation, by two kinds of nuclear collisions which are analogous to the photo-effect and the Compton effect of light quanta. The cross-sections for these processes are estimated. R. P.

3046. Molecular Structure of Selenium Dioxide Vapour. K. J. Palmer and N. Elliott. *Am. Chem. Soc., J.* 60. *pp.* 1309–1310, *June,* 1938.—Electron diffraction photographs of SeO_2 vapour have been interpreted to lead to the value $1·61 \pm 0·03$ Å for the Se-O distance. The value of the angle O-Se-O could not be determined. AUTHORS.

3047. Internuclear Distance in the Fluorine Molecule. L. O. Brockway. *Am. Chem. Soc., J.* 60. *pp.* 1348–1349, *June,* 1938.—The F-F distance in the F_2 molecule is found to have the value $1·45 \pm 0·05$ Å by the electron diffraction method. The value is about 14% greater than that expected for a normal single covalent bond. AUTHOR.

3048. Electronic Structure of the First Row Hydrides. G. W. King. *J. Chem. Phys.* 6. *pp.* 378–384, *July,* 1938.—Stehn's formulæ for the energies of the first row hydrides, BH to FH, in terms of Heitler-London exchange integrals have been applied to more recent data. The empirically derived values for the integrals are now smooth functions of the atomic number, Z. They are also considered as functions of the internuclear distance, r_e, and taken in conjunction with data on BeH, and with the facts that r_e and the force-constant, k, are smooth functions of Z, but invariant to electronic excitation, the results show that it is $2s^2 - 1s$ exchange that predominates in fixing the internuclear distance and force-constant. On the contrary, the dissociation energies cannot be expected to be smoothly dependent on Z, r_e or k. The heat of dissociation of NH is calculated by Stehn's formulæ, after interpolating one exchange integral. AUTHOR.

See also Abstracts **3045, 3064, 3323.**

COLLOIDS.

3049. Viscosity and Jelly Formation of Concentrated Sols of Hydrous Stannic Oxide. C. I. Varadanam. *Indian Acad. Sci., Proc.* 7*A*. *pp.* 327–332, *May,* 1938.—Krishnan's optical method has been employed to follow the changes in particle size in hydrous stannic oxide sol with the progress of dialysis. (*a*) Since $\rho_h = 1$ for the undialysed sol and continues to be at this value for the first five days of dialysis in the cold, it may be concluded that the particles are almost of molecular dimensions in the earlier stages of dialysis. (*b*) The value of ρ_h becomes less than one (from 1 to 0·49) with increased dialysis showing that the particle size has increased. (*c*) This increase in particle size is more rapid in hot than in cold dialysis. (*d*) ρ_v in both hot and cold dialysis is very low at all stages and is not much more than the error that may be attributed to a convergence of the incident beam. This indicates that the sol is made up of spherical particles. The adsorbed ammonia per gram of stannic oxide has been found to decrease rapidly at first and slowly thereafter with progress of dialysis. Viscosity determinations have also been made at different stages of dialysis and it is concluded that the increase of particle size has no correlation with the variation of viscosity. AUTHOR.

3050. Turbidity and Particle-Concentration of As_2S_3 Sols during Coagulation. K. Hoffmann and H. A. Wannow. *Kolloid Zeits.* 83. *pp.* 258–262, *June,* 1938.—Continuing their previous work [see Abstract 4781 (1937)], the authors have compared the variations of infra-red transmission and of particle concentration of As_2S_3 sols during coagulation. The curves for the light-transmission and the concentration of particles plotted against the activity coefficient of the added electrolyte are in all cases similar. Both the transparency and the number of particles decreases rapidly on coagulation. For each electrolyte used, the final concentration of particles is approximately the same, while the transparency varies with the valency of the flocculating ions. Ions of high valency, *e.g.*, La ions, give small, densely packed, aggregates, while monovalent ions give rise to larger incompact particles. For the smaller particles, the values for the light-transmission show approximate agreement with Rayleigh's theory, but as the particle-size increases during coagulation, an increasing divergence is found between the theoretical and the experimental curves. W. H. Wal.

3051. Silica Jellies. Part I. H. W. Batchelor. *J. Phys. Chem.* 42. *pp.* 575–585, *May,* 1938.—Studies have been made of gelation times and of shifts in pH value of silica sols and jellies as functions of concentration, initial pH value, and temperature. The data are expressed in the form of three-dimensional figures. The data permit a reconciliation of a number of conflicting statements in the literature regarding the influence of the factors mentioned. Minimum gelation time at constant concentration but at progressively lower temperatures appears to shift from acid through neutral and toward alkaline reactions. Several relations have been pointed out between the factors studied and the shift in H-ion concentration of silica sols during gelation. AUTHOR.

3052. Electrokinetic Potential. Parts I and II. K. Kanamaru, T. Takada and K. Aikawa. *Kolloid Zeits.* 83. *pp.* 288–299, *June*, 1938. Part I deals with the ζ-potential of a glass in various mixtures of dioxan and water as measured by the flow-potential method using a tetrode electrometer. In general, there is no complete connection between the ζ-potential and the difference of the dielectric constants of the two neighbouring phases. A strong deviation from the Coehn rule appears for that composition of the mixture in which the molecular polarisation of the liquid mixture exhibits a maximum. In Part II the ζ-potential of the glass is measured with respect to various mixtures of water and ethyl alcohol and of water and acetone. In these systems also there is no complete regularity (as on the Coehn rule) between the ζ-potential and the difference of the dielectric constants of the phases, while the above molecular polarisation effect is exhibited very clearly. The connection between the dielectric constant of the liquid mixture D, that of the glass D_g and the molecular polarisation $P_{1,2}$ is found to be expressed by the empirical formula $\zeta = 10^m (D - D_g)P^n_{1,2}$ where the constants *m* and *n* are almost the same for all systems. H. H. Ho.

3053. Theory of Electroosmotic Circulation in Varying Fields. P. White. *Phil. Mag.* 26. *pp.* 49–65, *July*, 1938.—The electroosmotic motion set up in a liquid by an alternating electric field is examined theoretically for laminar and cylindrical cells. In an experiment with a cell 3 mm. deep and a.c. of 1·3 ∼ results were obtained which were not in accordance with the usual theory of electroosmosis for steady fields, but which agreed well with the present theory. Results of previous experiments by other workers with a.c. also agree with the present theory. The behaviour of open cells (*e.g.*, of Tuorila's type) is examined and a criterion is given for determining whether a given cell will operate as a closed, partly closed, or open cell at a given frequency. A method is described whereby the theory can be extended from alternating fields to apply to fields varying with time in any manner. AUTHOR.

See also Abstracts 3114, 3215, 3281, 3292.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

3054. X-Ray Surface Reflection Fields and their Application to Absorption Corrections and to Background Patterns. M. J. Buerger. *Zeits. f. Krist.* 99. 3. *pp.* 189–204, 1938. *In English.*—A distinction is made between transmitted and surface X-ray reflections. The distribution of these two kinds of reflections on Weissenberg photographs is systematically derived for any crystal habit, for zero- and *n*-layer photographs, and for both the normal beam technique and the equi-inclination technique. Surface reflection fields appear to have at least two applications: 1. They are of aid in allowing for absorption in Weissenberg photographs. If the distribution of faces on the crystal is known, then the Weissenberg projection can be blocked out into contribution areas. 2. They provide an explanation for the distribution of background in Weissenberg photographs. Intense background patterns can be developed under appropriate conditions and they are characteristic of the crystal habit. It is suggested that background patterns may be of aid in the surface goniometry of crystals having faces too small or too imperfect for optical goniometric investigation. AUTHOR.

3055. Interpretation of Laue Photographs. C. C. Murdock. *Zeits. f. Krist.* 99. 3. *pp.* 205–216, 1938. *In English.*—The conception of Ewald's reciprocal lattice is applied to the interpretation of Laue photographs. A gnomonic projection of the Bragg planes in the crystal is easily constructed from the Laue photograph. This method however does not determine the absolute dimensions of the unit cell, which must be obtained by supplementing the method either by a density determination or a diffraction experiment with monochromatic X-rays. It is a method very useful for determining space groups, and a system of circles in the projection is described, which determines the boundary of spots corresponding to various layer lines. G. G.

3056. Ionic Spheres of Action. A. Pitschugin. *Zeits. f. Krist.* 99. 3. *pp.* 251–263, 1938.—The spheres of action of ions in crystals are estimated by purely geometrical considerations, without any auxilary hypotheses. This is done by finding the surfaces of zero potential around the ions. In NaCl, such a surface is spherical, but in crystals of lower symmetry it may be an ellipsoid of rotation or even an ordinary ellipsoid. It is found that, when spheres of action are determined in this way, the kations occupy a larger space than the anions—as they did in the older atomic radii of Bragg, though not in the revised values. It is pointed out that in determining these newer atomic radii some auxiliary hypothesis such as the size of O^{--} or F^{-} has been employed and that this may account for the difference. G. G.

3057. New Type of X-Ray Diagram. A. Guinier. *Comptes Rendus*, 206. *pp.* 1641–1643, *May* 30, 1938.—In the course of an X-ray investigation of alloys of Al and Cu it was observed that certain specimens gave a diagram of a type not previously recorded. The radiation (CuKα) was rendered monochromatic by reflection from a crystal. The usual type of diagram due to reflection from the planes of large oriented crystals is obtained, but in addition, there are a number of linear traces radiating from the centre. Their intensity is weak, and it is necessary to expose for an hour instead of the few seconds required for the normal diagram. The traces show intensity variations along their length. As the radiation is monochromatic they cannot be identified with the traces due to a continuous background in the primary radiation. The phenomenon may be explained by supposing that the Cu atoms are assembled in small groups distributed irregularly through the crystal but parallel to each other. The dimensions of these groups deduced from the diagrams are, diameter 150 Å and thickness 3–4 Å. This gives experimental verification of the ideas suggested by many metallurgists. C. J. B. C.

3058. Atomic Vibrations of a Zn-Cu Alloy. R. A. Howard. *Phys. Rev.* 53. *pp.* 966–971, *June* 15, 1938.—Measurements of X-ray reflection intensities at two temperatures have been made on the 2131 and 1015 lines from an alloy of Cu and Zn. The idea is put forward that the atomic vibrations should be greatest along the c axis of the crystal in case the axial ratio is greater than 1·633, least when the axial ratio is less than 1·633. The values obtained for the relative amplitudes of vibration along and perpendicular to the c axis confirm this idea. The relative atomic structure factors are also found and show a surprising dependence on the angle which the normal to the reflecting plane makes with the c axis.

AUTHOR.

3059. Structure of Talc and Pyrophyllite. S. B. Hendricks. *Zeits. f. Krist.* **99.** 3. *pp.* 264–274, 1938. *In English.*—X-ray diffraction data obtained from single crystals of talc and pyrophyllite verify the lattice dimensions as determined by Gruner. The structures are fixed in the a and c directions but individual $((OH)_2Al_2Si_4O_{10})_n$ or $((OH)_2Mg_3Si_4O_{10})_n$ layers are randomly shifted by some multiples of $b/6$ along the b axis. Most neighbouring layers probably have the same relation as two layers in the space group $C_s^4 - Cc$.

AUTHOR.

3060. Structure of Benzophenone. K. Banerjee and A. Haque. *Indian Journ. Phys.* **12.** *pp.* 87–94, *April,* 1938.—Cell dimensions of benzophenone have been determined by rotation photographs to be $a_0 = 10 \cdot 17$, $b_0 = 12 \cdot 06$ and $c_0 = 7 \cdot 98$ Å, with 4 molecules per unit cell. From a combination of oscillation and Weissenberg camera photographs the space-group has been found to be $D_2^4P2_12_12_1$. From considerations of the magnetic anisotropy of the crystal the two benzene rings in the benzophenone molecule have been found to be inclined to each other at 135° nearly, the connecting C atom lying at the intersection of these two planes. The line bisecting the acute angle between these planes lies along the b-axis, while the mean plane is inclined to the c-axis by 22° 25′. [See also Abstracts 2311 (1937) and 1406 (1938)].

AUTHORS.

3061. New Form of Resorcinol. Part I. Structure. Part II. Thermodynamic Properties. J. M. Robertson and A. R. Ubbelohde. *Roy. Soc., Proc.* 167*A. pp.* 122–147, *July* 7, 1938.—In Part I the structure of the dense, high temperature modification of resorcinol has been fully determined by means of a quantitative X-ray investigation. The structure is characterised by a more compact and parallel arrangement of the molecules than in ordinary resorcinol, which is a rather open arrangement. The benzene rings are apparently regular hexagons to within 0·05 Å, but the OH groups are definitely displaced from the symmetrical positions, and one of them at least is also displaced out of the plane of the ring. The C-O distances are 1·36-1·37 Å, as in ordinary resorcinol. The orientation of the molecule in the crystal and the atomic coordinates are given. OH bonds of length 2·70 and 2·75 Å connect neighbouring molecules in the crystal, but the angles between these bonds are further distorted from the tetrahedral value than in ordinary resorcinol. All other intermolecular distances are greater than 3·4 Å.—In Part II the anomalous temperature relationship between the polymorphs of resorcinol is discussed in the light of the crystal structures. The open α-structure is maintained by OH bonds orienting the rigid resorcinol molecules. Transition to the denser β-structure, which resembles that of many hydrocarbons, is associated with a distortion of the OH bonds, and a deformation of the resorcinol molecule which may involve a Mills-Nixon effect. Experiments are described on the preparation of α- and β- resorcinol, on the transition between the two forms, and on the heat of transition. The transition point of $C_6H_4(OH)_2$ is about 2° lower than that of $C_6H_4(OD)_2$, and the change from one form to the other is considerably more rapid in the D compound. The heat of transition from α- to β-resorcinol is 220 ± 50 cal./mol. Experiments on the volume change from (supercooled) liquid resorcinol to either crystal structure show that there is only a small expansion on passing from the open α-structure to the liquid. Experiments on the transition between two polymorphs of pentaerythritol show a normal temperature relationship for this substance. AUTHORS.

3062. Structure of Condensed Ring Compounds. Part VI. 1:2-Benzanthracene, 5-Methyl-1:2-Benzanthracene and 3-Methyl-1:2-Benzanthraquinone. J. Iball. *Zeits. f. Krist.* 99. 3. *pp.* 230–237, 1938. *In English.*—The X-ray crystal data for 1:2-benzanthracene and two derivatives are as follows:

	1:2-Benzanthracene (monoclinic)	5-Methyl-1:2-Benzanthracene (monoclinic)	3-Methyl-1:2-Benzanthraquinone (monoclinic)
a (Å.)	7·91	8·21	7·52
b (Å.)	6·43	6·53	16·81
c (Å.)	23·96	48·4	11·63
β	99°	90°	118·9°
Probable space group	C_2^2—$P2_1$	C_{2h}^4—$P2/c$	C_{2h}^5—$P2_1/a$
Mol. per unit cell	4	8	4
Density (meas.)	1·245	1·231	1·393
Density (calc.)	1·257	1·233	1·403
Optic sign	(+)	(—)	(—)
Optic orientation	$\beta=b$, $\gamma=c$	$\beta=b$, $\gamma=c$	$\beta=b$, $\gamma=2{\cdot}5°$ from c in obtuse β angle

Molecular arrangements are suggested which agree with the above data and the main intensities of reflection. [For Part V see Abstract 5374 (1936).]. J. I.

3063. Optical Crystallographic Studies with the Polarising Microscope. Part I. W. M. D. Bryant. *Am. Chem. Soc., J.* 60. *pp.* 1394–1399, *June*, 1938.—Optical crystallographic constants of three forms of acet-*p*-bromoanilide and two forms of propion-*p*-bromoanilide have been determined for use as criteria in the identification of the pure derivatives. In addition to the more frequently reported optical constants, acute and obtuse optic axial angles in cedar oil have been measured, and have proved very useful in the above capacity. Optic axial angles in a binary mixed crystal system of acet- and propion-*p*-bromoanilides have been determined for five monochromatic radiations of the mercury arc. Melting points for the same system have also been determined. By means of these physical data, the weight compositions of various binary mixtures can be determined semiquantitatively. Three types of crystal dispersion have been observed in measurable intensity in the above mixed crystal system: axial, crossed axial plane, and "monoclinic" crossed dispersion. The first and second are functions of composition. AUTHOR.

See also Abstracts 3117, 3169, 3174, 3293, 3335, 3369, 3400.

DENSITY.

3064. Limiting Density of SO_2. E. Moles, T. Toral and A. Escribano. *Comptes Rendus,* 206. *pp.* 1726–1728, *June* 8, 1938.—A determination of the limiting density of SO_2 has been made. Experiments with the appropriate corrections, were made in vessels of Jena glass and of Thuringia glass, and the results are identical with those recently reported by E. Moles [see Abstract 943 (1938)]. The SO_2 was obtained from the liquid SO_2 of commerce and also by the action of concentrated H_2SO_4 on Hg. It was passed through H_2SO_4 and dried by P_2O_5 or $Mg(ClO_4)_2$, liquefied and then fractionated. Measurements were made at pressures of 760, 507, 380, and 253 mm. of Hg. Practically identical results were obtained in the vessels made of the two different glasses, the limiting density being expressible by $Lp = 2{\cdot}85794_8 + 0{\cdot}06860_7 p$. The molecular weight of the SO_2 works out to be 64·062 (Thuringia glass) and 64·063 (Jena glass), with corresponding values of 32·062 and 32·063 for the atomic weight of S. G. G.

DIFFUSION AND OSMOSIS.

See Abstract 3324.

ELASTICITY AND PLASTICITY.

3065. Elasticity Equations of Domes of Rotation Deduced Elementarily. O. Zanaboni. *Accad. Sci. Torino, Atti,* 73. *Disp.* 2*a. pp.* 194–202, *Jan.–March,* 1938.—The relations of the elastic constants of a plane body and the displacements in polar coordinates are obtained by changing from cartesian coordinates, thus getting the specific deformation in terms of the external displacements. By simple deduction, the equations are obtained for a dome of rotation loaded uniformly along parallels and the possible deformations are seen to be dilatation and a variation in curvature. H. M. B.

3066. Flexure and Shear with Associated Torsion in Prisms of Uniaxial and Asymmetric Cross-Section. A. C. Stevenson. *Roy. Soc., Phil. Trans.* 237*A*. *No.* 776. *pp.* 161–229, *April* 14, 1938.—A complete solution of the flexural problem for a uniform prism is obtained, and detailed solutions are worked out by the methods developed, including a case where the section has no axis of symmetry. The main contribution of the paper is the discovery that the solution can be effected in terms of a set of three functions satisfying simple boundary conditions, along with their conjugates. These are analogous to the well-known torsion function, which is indeed itself one of the set. W. G. B.

3067. Equilibrium of Deformable Membranes. H. Pailloux. *Comptes Rendus,* 206. *pp.* 1706–1708, *June* 8, 1938.—The equilibrium of deformable surfaces such that at each point the different tensions have the same direction except that in one direction the tension is zero, is discussed mathematically. The stresses can be realised by a large number of threads stretched over the surface of a rubber balloon. J. S. G T.

3068. Improved Calculation of the Energies of Metallic Li and Na. J. Bardeen. *J. Chem. Phys.* 6. *pp.* 367–371, *July,* 1938.—The method of calculation used in the present work is a modification of that used by Wigner and Seitz in their original calculations of the energies of metallic Li and Na. The main difference lies in an improved method for the calculation of the Fermi energy. In each polyhedral cell, the wave function of an electron is taken to be of the form $\psi_k = [u_0(r) + i(\mathbf{k}\cdot\mathbf{x})$

$(v_1(r) - u_0(r))]$ exp [$i\mathbf{k}\cdot\mathbf{x}$], where $u_0(r)$ and $v_1(r)$ are radial *s* and *p* functions, respectively, which depend only on the distance from the ion in the centre of the cell. Both functions are determined explicitly from the differential equations, and the energy of the electron is expressed in terms of the boundary values of the wave function. Values of the Fermi energy, and of the total energy of each metal, are tabulated as a function of the lattice spacing. Calculated values of the lattice constants, heats of sublimation, and compressibilities are in fair agreement with experiment. [See Abstract 1309 (1935) and following Abstract.] AUTHOR.

3069. Compressibilities of Alkali Metals. J. Bardeen. *J. Chem. Phys.* 6. *pp.* 372–378, *July*, 1938.—As a further test of the method of Wigner and Seitz (for the calculation of the energies of the monovalent metals), the pressure variation of the compressibilities of the alkali metals is determined and compared with recent experimental results of Bridgman which extend to pressures of the order of 45,000 kg./cm^2. Fröhlich's approximate analytic expression for the dependence of the energies of the alkali metals on volume suggests the following semi-empirical form: $W = a/v + b/v^{2/3} - c/v^{1/3}$. If the parameters are determined from (1) the lattice constant, (2) the energy, and (3) the compressibility (all at zero pressure), the expression gives values for the relative change in volume with pressure in close agreement with Bridgman's results. The constants so determined agree fairly well with Fröhlich's theoretical values. Compressibilities of Li and Na, as obtained from the more exact and fundamental calculations of the energies given [see preceding Abstract] are compared with the experimental values. Theoretical values for Na are in good agreement with experiment, but the corresponding values for Li are about 15% too high. It is suggested that the polymorphic transition in Cs, which occurs at a pressure of about 22,000 kg./cm^2., is a transition from the normal body-centred to a face-centred form, resulting from the non-electrostatic interaction energy of the ions, which favours close packing. AUTHOR.

3070. Forced Vibrations of a Holonomous System with Two Degrees of Freedom. A. Nadile. *Accad. Sci. Torino, Atti,* 73. *Disp.* 2*a*. *pp.* 187–193, *Jan.–March,* 1938.—If a vibrating system having one degree of freedom is subjected to a sinusoidal forcer, the amplitude of the forced oscillation may be reduced by coupling the first system to a second having one degree of freedom. In order that the action of the latter may be as great as possible its frequency should coincide with the mean frequency of the forcer. H. M. B.

3071. X-Ray Investigation of Failure of Metals. H. J. Gough and W. A. Wood. *Brit. J. of Radiology,* 11. *pp.* 479–488, *July,* 1938.—A survey is made of some outstanding points in the problem of failure of metals, and particularly of those points in which the application of X-ray methods are likely to lead to profitable results. These issues are illustrated by some recent X-ray investigations on fracture of metals under static deformation and also by fatigue, and it is shown how this work has provided a systematic foundation for regarding the general problem. AUTHORS.

See also Abstracts 3099, 3127, 3169, 3326.

GRAVITATION.

***3072. Comparison of Direct and Loop Measurements with the Thyssen Gravimeter. S. v. Thyssen.** *Beitr. z. angew. Geophys.* 7. 3. *pp.* 218–229, 1938.—Direct and loop measurements with several Thyssen gravimeters are compared over a considerable area near Hanover for the same stations, 0·5–6 km. apart. The loop measurements show mean errors not exceeding on the average double those shown by the direct measurements. For loop measurements an instrument little affected by temperature variations is to be preferred. [See Abstract 5056 (1936).] C. A. S.

*3073. **Error Frequency Curves as a Measure of Accuracy and their Employment with the Thyssen-Gravimeter. F. Lubiger.** *Beitr. z. angew. Geophys.* 7. 3. *pp.* 230–244, 1938.—The accuracy of measurements with several Thyssen gravimeters is investigated mathematically by means of error-frequency curves, which give a clearer insight into the accuracy obtainable than error-probability curves, as these measurements involve, not the actual errors of an observation, but merely the difference between the errors of two observations. The error-frequency curves of the several instruments closely resemble each other, and there is some indication of the existence of systematic as well as of accidental errors. C. A. S.

*3074. **Marine Gravimetric Methods and Surveys. M. Ewing.** *Am. Phil. Soc., Proc.* 79. 1. *pp.* 47–70, 1938.—The development and method of operation of the Meinesz apparatus for gravity observations at sea are described while later modifications which give greater accuracy are mentioned. The effect of second order disturbance terms is discussed. The negative gravity anomalies in the E. Indies, W. Indies and Nippon trench are described. These coincide with the belts of earthquake epicentres, volcanoes being on the concave and the deep sea troughs on the convex sides. Positive anomalies over the oceans are smaller but the explanations of them are considered inadequate. The static gravity meters for marine measurements are discussed and finally the relation of isostasy to the figure of the earth is treated in the light of these results. R. S. R.

*3075. **Second-Order Disturbance (Browne) Terms in Pendulum Observations at Sea. F. A. V. Meinesz.** *K. Akad. Amsterdam, Proc.* 41. 6. *pp.* 540–551, 1938.—A more durable shape of apparatus was constructed to obtain the horizontal accelerations of a ship when submerged and it gave full satisfaction during tests on a voyage from Curaçao to the Azores and Helder. A summary is given of the results obtained. Corrections are applied to the old results for 454 gravity stations. The theory of the method is supplied. R. S. R.

See also Abstracts 3100, and

2394B. Synthetic Law of Gravitation and Electromagnetism. J. Hély.

HYDRODYNAMICS AND AERODYNAMICS.

3076. **Slow Movements of a Compressible Fluid. C. Jacob.** *Accad. Lincei, Atti,* 27. *pp.* 176–181, *Feb.* 20, 1938.—A formula due to Cisotti relative to the coefficient of contraction of a liquid jet allows a qualitative study to be made of the case. The author of the present paper develops an analogous formula for a compressible fluid and deduces some consequences from it. J. J. S.

3077. **Rigid Configurations of Vortical Filaments Perpendicular to a Plane. L. Sona.** *Accad. Lincei, Atti,* 27. *pp.* 80–85, *Feb.* 6, *and pp.* 182–184, *Feb.* 20, 1938.—After preliminary references to the work of W. B. Morton [see Abstract 1838 (1934)] and J. J. Thomson [*Vortex Rings, p.* 107, 1883], the author deals in this paper with the problem of *n* vortical filaments perpendicular to a plane under the influence of their mutual actions, it being laid down that there be assumed as unknown functions the squares ρ_{hs} of their reciprocal distances. Some of Morton's results are extended. In the second paper various particular cases are considered.

J. J. S.

3078. Hydrodynamic Sources. U. Cisotti. *Accad. Sci. Torino, Atti,* 73. *Disp.* 2*a*. *pp.* 245–254, *Jan.–March,* 1938.—Solutions of expressions relating to the motion of a perfect fluid, in which a point source is assumed, give an infinite value to the velocity at the source, and consequently in the neighbourhood the pressure is negative. The present paper is an attempt to regularise the conditions near the source without giving up the hypothesis of a perfect fluid. W. A. R.

3079. Steady Two-Dimensional Motion of a Viscous Fluid Past a Fixed Circular Cylinder. B. A. Griffith. *J. Math. Phys.* 17. *pp.* 5–42, *March,* 1938.—Since the Stokes' approximation in the problem of the flow of a viscous fluid past a fixed obstacle is good near the obstacle, but not at a distance, while Oseen's is good at a distance and not so good near the obstacle, it would seem that a better approximation might be obtained by using the former within, and the latter without, some surface surrounding the obstacle, making the two solutions join smoothly on this surface. The analysis is carried out for the particular case of a circular cylinder, the additional surface being taken as a concentric cylinder. If the radius of the fixed cylinder is a and that of the other $a\,\xi$, the resistance calculated will be a function of ξ, as well as the Reynolds number, R; it is found to decrease with increasing ξ for all values of R. Agreement with experiment in the range $0 \leq R < 20$ can be obtained by choosing a ξ which decreases as R increases; any hypothesis leading to a choice of ξ would, however, be entirely arbitrary. The results verify the calculations of Bairstow, when $\xi = 1$. Stokes' and Oseen's equations are both integrated by a new method, employing complex variables, and the possible equivalent sets of conditions which ensure the smooth join of the two solutions are discussed. W. G. B.

3080. Waves on Water of Finite Depth Due to Disturbance on the Surface. Y. Nomura. *Tôkohu Univ. Sci. Reports,* 11. *pp.* 687–713, *April,* 1938. *In English.*—In this paper is discussed the problem of determining the wave motion of finitely deep water due to an initial displacement of the free surface without initial velocity and due also to an initial impulse applied on the surface without initial surface displacement. Two special types of distribution of the initial disturbance are considered.

AUTHOR.

3081. Lift and Drag Functions for an Elastic Fluid in Two-Dimensional Irrotational Motion. H. Bateman. *Nat. Acad. Sci., Proc.* 24. *pp.* 246–251, *June,* 1938.—A number of transformations of, and results concerning, these functions are obtained. W. G. B.

3082. Indeterminacy of the Stream Impulse in a Fluid of Infinite Extent. W. Tollmien. *Zeits. f. angew. Math. u. Mechanik,* 18. *pp.* 151–154, *June,* 1938.—The case of the translatory acceleration of a sphere in an infinite, non-compressible fluid is discussed mathematically and it is shown that the expression for the impulse on the sphere is indeterminate, depending upon how the limiting form of the fluid at infinity is approached, *e.g.*, whether as the limit of a spherical or a circular-cylindrical boundary. J. S. G. T.

***3083. Measurements of Turbulent Fluctuations. H. Reichardt.** *Naturwiss.* 26. *pp.* 404–408, *June* 17, 1938.—The nature and significance of fluctuations in turbulent flow are briefly and simply explained. Apparatus, comprising three heated wires arranged triangularly, for measuring the 3 principal turbulences in a stream of fluid is described, and oscillographic and electro-dynamometric methods of recording the turbulences are explained. J. S. G. T.

See also Abstracts 3165, 3302.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

3084. Complementary Heaviside Operator. T. Sakurai. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 355–364, *May*, 1938. *In English.*—The complementary Heaviside operator, (q), is defined by the equation $q^{\mu} x^{m} = \pi(\mu - m - 1)\, x^{m-\mu}/\pi(-m-1)$. Its properties in x space, in the space of Heaviside's p operator, and in the space of Milne-Thomson's operator are discussed. Goursat's and Borel's theorems are expressed in terms of q. The operational representation of $x^{\mu} f(x)$ is usually regarded as $(-d/dp)^{\mu}$ $g(p)$, if the relation $f(x) = g(p) \cdot 0$ exist; this does not hold when μ is not an integer. J. S. G. T.

3085. Non-Linear Partial Differential Equations of the Elliptic-Parabolic Type. M. R. Siddiqi. *Indian Journ. Phys.* 12. *pp.* 109–119, *April*, 1938.—The Fourier method developed by the author for the unique solution of general non-linear equations of the parabolic and hyperbolic types has been extended to the non-linear partial differential equation of the elliptic-parabolic type $\partial^2 u/\partial x^2 + \partial^2 u/\partial y^2 + \partial u/\partial t = u^2$ and for certain boundary and initial conditions, unique solution has been obtained. AUTHOR.

3086. Graphical Solution of Ordinary Differential Equations. V. A. Bailey and J. M. Somerville. *Phil. Mag.* 26. *pp.* 1–31, *July*, 1938.—The authors show how a number of simple and inexpensive graphical devices may be applied to the solution of a large class of ordinary differential equations such as are frequently met with in applied mathematics. The treatment is general and emphasis is laid on the method of attack rather than on the solution of particular equations. In a subsequent paper, the application of these methods to particular equations of importance in various branches of applied mathematics will be given in greater detail. AUTHORS.

3087. Law of Error and the Combination of Observations. H. Jeffreys. *Roy. Soc., Phil. Trans.* 237*A*. *No.* 777. *pp.* 231–271, *April* 14, 1938.—The limitations of the theoretical grounds for accepting the normal law of errors of observation are discussed, and seven series of observations capable of providing tests of its truth are examined. It is found that the χ^2 test, as usually employed, is not sufficiently sensitive to establish departures from the normal law. A wider grouping, however, reduces the random error of χ^2 sufficiently to show the departures clearly, though it is still less sensitive than the ratio of the maximum likelihood solution for the departure to its standard error. It appears that no form of the test is of much use when the law to be tested implies very small expectations in some of the groups. An approximation to the method of maximum likelihood for Pearson laws of Types II and VII is developed, and extensions to Types I and IV are suggested. The approximation does not involve an excessive amount of labour or the retention of a large number of figures. It is found that the various series of data give laws ranging from Type II with index 4·5 to Type VII with index 4·3, and that the index is closely correlated with the degree of correlation of the errors within groups of successive observations; an extrapolation using this correlation suggests that genuinely independent observations would follow a law of Type VII with index between 3 and 4. Methods of combining observations following such a law and determining their uncertainties are provided. It appears that a number of discrepancies in astronomy and physics that have been accepted as systematic may turn out to be random, since with such a law large random discrepancies may occur more often than with the normal law if the mean and the mean square deviation are still used as estimates. AUTHOR.

3088. Natural Dimensions of Physical Quantities. E. H. Kennard. *Am. Phys. Teacher*, 6. *pp.* 120–123, *June*, 1938.—It is suggested that the unqualified term *dimensions* of a physical quantity should be restricted to mean the dimensions or relative change-ratios of the unit and numeric that occur in the numerical measure of the quantity. The *natural dimensions* of a quantity are independent of the units employed in measuring it. Whenever the definition of a magnitude inserts into its measure the measure A of another magnitude as a factor A^n, but in no other way, the first magnitude is considered to have *definitional dimensions n* in terms of the second. The writer suggests that all 3 concepts of dimensions can coexist, and discusses the relation between them. Confusion has been made easy by the fact that physical definitions are usually so drawn that definitional and natural dimensions coincide whenever the natural ones are known. Particular cases discussed include: mechanical quantities, temperature, angle, and electrical and magnetic magnitudes. A. Hu.

***3089. Calculating Devices. W. Meyer zur Capellen.** *Zeits. f. Instrumentenk.* 58. *pp.* 221–228, *June*, 1938.—Variation in the position and form of the essential components of a mechanical model of a simple nomogram results in arrangements capable of dealing with diverse algebraic and trigonometrical expressions. P. H. B.

3090. Symmetry. H. Weyl. *Washington Acad. Sci., J.* 28. *pp.* 253–271, *June* 15, 1938.—In this lecture the author discusses the extensive rôle which symmetry plays both in art and nature, and by what concepts the mathematicians have approached this phenomenon. Bilateral symmetry is first considered and followed by a study of rotational and central symmetry. A motion carrying a figure as a whole into itself may be called an automorphism of the figure, and symmetry is described by the group of automorphisms. If the group of automorphisms of a given ornament contains translations at all there are only two possibilities, *viz.*: (1) All translations of vectors are multiples of one basic vector: simple infinite rapport or band ornament. (2) They arise by composition from two basic vectors of different direction: double infinite rapport or surface ornament. The problem of lattices is next described, and it is stated that there are 17 essentially different kinds of symmetry possible for a two-dimensional ornament; these are all found among the Egyptian ornaments. Finally, three-dimensional symmetry is considered, *viz.*: the 230 symmetry groups divided into the 32 classes, and although art has never gone in for solid ornaments, the arrangements of the atoms in a crystal are such patterns. Other important applications of symmetry in physics and mathematics, *e.g.*, theory of relativity, quantum theory applied to atomic and molecular spectra, and Galois's theory are briefly described. H. H. Ho.

See also Abstracts 3355, and
2395B. Solution of Differential Equations. G. Gentini.
2399B. Free Vibrations in Systems with Several Degrees of Freedom. W. M. Dudley.
2400B. Determinant of Certain Matrices. L. R. Walker.

MECHANICS, QUANTUM.

3091. Monochromatic Plane Wave Solutions of Dirac's Equation. G. Petiau. *J. de Physique et le Radium,* 9. *pp.* 171–177, *May,* 1938.—An expression for the solutions is found as linear functions of $W, p, m_0 c$ such that the amplitudes of the general solution are represented by $\Sigma_m a_{em} A_m$. Two forms for this are found according as the energy is positive or negative. This solution allows a simple calculation of the mean density of an operator K, and is applied to the computation of the densities of magnitudes corresponding to the 16 matrices of the Dirac system. N. M. B.

3092. Energy-Momentum Tensor and Charge-Current Vector in Dirac's Equations for Particles with Spin Greater than ½h. J. M. Jauch. *Helv. Phys. Acta,* 11. 4. *pp.* 374–377, 1938. *In German.*—The question as to the existence of energy-momentum tensor and density-current vector in the generalised Dirac equations is investigated. The conclusions arrived at are that for zero rest mass an energy can be defined only for a spin of ½ or 1 unit, a density only for ½ unit. For finite rest mass, however, an energy tensor can be defined for arbitrary spin. R. P.

3093. Proper-Values of Fundamental Operators in Dirac Election Theory. G. Petiau. *Comptes Rendus,* 206. *pp.* 1455–1457, *May* 16, 1938.—Given the wave-functions of the electron it is shown how the probabilities of the proper-values of the Dirac matrices may be obtained by purely symbolic algebra. G. C. McV.

3094. Application of Method of Self-Consistent Field to Atomic Nuclei. M. Matricon. *Comptes Rendus,* 206. *pp.* 1809–1812, *June* 13, 1938.—Analytical expressions of equations determining the individual wave functions of nuclear particles [see Abstract 1841 (1938)] are modified by the decomposition of each individual wave function into the product of a space wave and a spin wave. The equations are applied to the He nucleus and initial and final wave functions are tabulated. The value of the nuclear binding energy calculated by the self-consistent field method is $-53\cdot26$, compared with $-50\cdot75$ by the Ritz-Heisenberg method, and -55 the actual value. N. M. B.

3095. Relativistic Commutation Rules in the Quantum Theory of Fields. M. Schönberg. *Physica,* 5. *pp.* 553–560, *July,* 1938. *In English.*—In the present paper are discussed the commutation rules between the field quantities at different times. Commutation rules for electron waves are established with the general assumption of a variable electromagnetic field. For an arbitrary material field with first order equation of motion the commutation rules are seen to be analogous to those of the electron. The case of the neutrino field is examined. Jordan and Pauli's rules [see Abstract 1340 (1928)] for the electromagnetic field strengths are analysed in connection with Maxwell's equations; it is shown that the rules can be written in a symmetrical form similar to those of a material field. AUTHOR.

3096. Reciprocal Action. D. Iwanenko. *Phys. Zeits. d. Sowjetunion,* 13. 2. *pp.* 141–150, 1938. *In German.*—A discussion is given of the various possibilities of the reciprocal action transfer between nuclear particles in the cases of Fermi and Bose particles. A comparison between the Dirac and the Fermi models of the origins of such particles is sketched. G. O. B.

3097. Central Limit Theorem of Statistical Mechanics. K. Husimi. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 377–390, *May,* 1938.—Some unsatisfactory points in a previous memoir [see Abstract 978 (1938)] generalising the Darwin-Fowler method, are clarified, the chief results of quantum statistics on the basis of this treatment are outlined with special reference to the limit theorem, and two theorems concerning the Fermi and Bose transformations are developed. N. M. B.

See also Abstracts 3068, 3069, 3072.

PHILOSOPHY OF SCIENTIFIC METHOD.

3098. Classification and Perception of Similarity. W. H. George. *Nature,* 141. *pp.* 1055–1056, *June* 11, 1938.—Classification is based upon human perception of similarity. In an attempt to get experimental data on the readiness with which similarities are noted, objects were exposed in pairs and observers were asked to compare them. The reports of those observers who understood by " compare," that both similarities and dissimilarities were to be recorded, were analysed in terms of the number of each noted. In three sets of experiments, involving about 40 observers, from two to five times as many dissimilarities as similarities were noted. It is concluded that with unprejudiced observers, perception of similarity upon which classification depends, is more difficult or less " natural " than perception of dissimilarity. A certain philosophical interpretation of the results is rejected as unscientific. W. H. G.

PRESSURE.

3099. Tension Experienced by an Ellipsoidal Balloon Envelope. L. Lecornu. *Comptes Rendus,* 206. *pp.* 1769–1773, *June* 13, 1938.—Previous work on the equilibrium of flexible and inextensible surfaces is extended to the case where variation of pressure is produced by the difference of specific weight of the gas in the envelope and that of the surrounding air. Equations are established to determine the tension existing. **Errata,** *ibid. pp.* 2011, *June* 27, 1938. R. S. R.

RELATIVITY AND ETHER.

3100. Mass and Gravitation. J. Roubaud-Valette. *Comptes Rendus,* 206. *pp.* 1556–1558, *May* 23, 1938.—In flat space-time of five dimensions, it is possible by the introduction of a suitable gravitational potential, to derive the equation of motion of a particle under gravity in a form invariant under Lorentz transformations. G. C. McV.

3101. Biquaternions in Born's Electrodynamics. B. S. M. Rao. *Indian Acad. Sci., Proc.* 7A. *pp.* 333–338, *May,* 1938.—The investigation previously reported [see Abstract 526 (1937)] of the relationship of the complex representations of Schrödinger and of Weiss to Born's field theory is extended by consideration of the type of complex representation with biquaternions due to Watson [see Abstract 1371 (1937)]. Alternative symmetrical representations by biquaternions are given, and it is shown possible to set up a biquaternion representation corresponding to Born's action-function in the generalised Infeld form of a sum of a Lagrangian and a Hamiltonian; finally a biquaternionic interpretation is given of the fundamental parameters introduced in the generalised action-function theory. N. M. B.

See also Abstract 3394.

SOLUTION.

3102. Regular Gas Solutions. I. R. Kritschewsky. *Acta Physicochimica,* 8. 5. *pp.* 641–646, 1938. *In German.*—The theory of regular solutions developed by Hildebrand and his co-workers for liquid solutions is now applied to gases, and an equation for P–V–T dependence derived, viz., $P_{reg.} = P_1^0 N_1 + P_2^0 N_2 + f(V_1 N_2)$, where $f(V_1 N_2)$ is a thermodynamic undetermined function of volume and composition but not of temperature, $P_{reg.}$ is the total pressure of the regular gas solution, P_1^0 and P_2^0 are the pressures of the pure components for the mol. volume V, and N_1 and N_2 are the respective mol. fractions. This equation satisfies the data of Gilliland for the systems $CH_4 - N_2$, $A - C_2H_4$ and $H_2 - CO$. It is shown that Bartlett's rule, $P = P_1^0 N_1 + P_2^0 N_2$, is a special case of the general equation. H. H. Ho.

3103. Ions in Solution. H. S. Harned. *Frank. Inst., J.* 225. *pp.* 623–659, *June,* 1938.—Recent developments in the thermodynamical theory of solutions and experimental work are reviewed. Among the subjects treated are the following: the activity coefficients of KCl, and HCl in water as determined by different experimental methods; the thermodynamics of aqueous NaCl solutions; the derivation of partial molal heat content from heat of dilution and e.m.f. data; the derivation of relative partial molal heat capacity from calorimeter and e.m.f. data; the ionic activity coefficient product and ionisation of water in halide solutions; evaluation of the standard potential of the H_2 – AgCl cell in dioxane-water mixtures; extrapolation to saturated solutions and the calculation of the solubility of highly soluble salts in salt solutions by the method of Åkerlöf. A Bibliography of 87 references is appended. J. S. G. T.

3104. Mixtures of Ampholytes. A. Boutaric. *Ann. Soc. Sci. de Bruxelles,* 58. *pp.* 154–160, *June* 24, 1938.—The precipitation of a complex from mixtures of ampholytes by combination of anions and kations is mathematically discussed in general. The maximum precipitation is dealt with and the concentration of neutral (non-electrified) molecules. It is shown that in systems of several ampholytes the study of conductivity enables the indication of isoelectric points. H. H. Ho.

3105. Solutions of Electrolytes in Non-Aqueous Solvents. C. A. Kraus. *Frank. Inst., J.* 225. *pp.* 687–707, *June,* 1938.—The paper consists of a critical discussion of the behaviour of electrolytes in non-aqueous solvents. The solvents considered were ethylene chloride and pyridene. The electrolytes include complex organic compounds. F. J. B.

3106. Solubility of Haloforms in Donor Solvents. G. F. Zellhoefer, M. J. Copley and C. S. Marvel. *Am. Chem. Soc., J.* 60. *pp.* 1337–1343, *June,* 1938.—The solubilities of a series of halogenated methane and ethane derivatives in many types of organic solvents were measured. The existence of a C–H ← O or C–H ← N type of H bond is postulated to correlate the observed solubilities. AUTHORS.

3107. Aqueous Solubilities of Isomeric Hexanols. P. M. Ginnings and R. Webb. *Am. Chem. Soc., J.* 60. *pp.* 1388–1389, *June,* 1938.—Aqueous solubilities of ten isomeric hexanols were determined for 20, 25 and 30°. The three tertiary isomers are more soluble than any of the six secondary isomers which in turn are more soluble than the most compact primary isomer. Maximum solubility is obtained by having the OH group as close as possible to the centre of a compact molecule. The solubility of all ten isomers decreases as the temperature increases from 20 to 30°. AUTHORS.

3108. State of Solution of Highly-Polymerised Substances. S. Papkov, S. Rogovin and V. Kargin. *Acta Physicochimica,* 8. 5. *pp.* 648–658, 1938. *In German.*—Experimental data, especially on the system acetylcellulose-chloroform, are adduced in support of the view that the state of solution of highly-polymerised substances is analogous to that in systems consisting of two liquids. It is pointed out that the phase rule is applicable, the substance of high molecular weight being present as a molecular solution and not as a colloidal dispersion. L. A. W.

SURFACE PROPERTIES.

3109. Sorption of Chlorine by Activated Charcoal. L. H. Reyerson and A. W. Wishart. *J. Phys. Chem.* 42. *pp.* 679–685, *May,* 1938.—Sorption isotherms for Cl_2 on activated charcoal were obtained at 35·5°, 51·0°, 73·5° and 91·5° C. Comparison of these results with those of Br_2 and I_2 is made. Calculations show the minimum surface area of the activated charcoal to be $5 \cdot 54 \times 10^6$ cm^2. AUTHORS.

3110. Adsorption of Gases by Graphite. A. B. Lamb and E. N. Ohl. *Am. Chem. Soc., J.* 60. *pp.* 1287–1290, *June,* 1938.—The observed adsorption of gases on graphite is not due to the entrance of the gaseous molecules into the spaces between the basal planes of the graphite crystal, but rather to adsorption upon the external surfaces of the crystallites. The same is true as regards the much greater adsorption of gases upon the C produced in the " explosion " of graphitic oxide, although samples of this C were prepared which adsorbed nearly half as much CO_2 as does highly activated cocoanut charcoal. Graphite obtained by heating SiC until the Si is gone, yet retaining the external form of the carbide crystals, adsorbs at liquid N_2 temperatures only about one-fourth as much H_2 as does ordinary graphite. AUTHORS.

3111. Adsorption of He on Charcoal. A. van Itterbeek and W. van Dingenen. *Physica,* 5. *pp.* 529–540, *June,* 1938. *In English.*—The authors continue their previous investigations on adsorption isotherms of gases at low temperatures [see Abstract 486 (1938)]. Measurements made on the adsorption of He gas on charcoal between 20° and 6° K. and for pressures between 1 mm. and 70 cm. showed complete agreement with Williams' theory of adsorption. The temperatures between 10° and 6° K. were realised by means of a new desorption apparatus of simple construction. From the adsorption isotherms, the authors have calculated the heats of adsorption as a function of pressure and temperature by applying the Clapeyron-Clausius equation. The results obtained for the heats of adsorption are discussed. Desorption experiments made with H_2 as adsorbed gas led to the conclusion that it must be possible to reach the critical point of H_2. W. H. WAL.

3112. Adsorption on a Uniform Surface. J. B. Zeldowitsch. *Acta Physicochimica,* 8. 5. *pp.* 527–530, 1938. *In English.*—A definition is given of a uniform surface, which remains valid when thermal agitation and surface fluctuations are present. The adsorption process is examined on the basis of different assumptions regarding the relation between the time of relaxation of the surface and the time of adsorption. AUTHOR.

3113. Adsorption of H_2 and O_2 on Pt at High Temperatures. B. Erschler, G. Deborin and A. Frumkin. *Acta Physicochimica*, 8. 5. *pp.* 565–576, 1938. *In German.*—Pt, after heating in H_2, was found to contain 2½ times less removable H_2 at the surface than was contained on kathodically polarised Pt. A proportion of strongly combined H_2 was recognised. As had the effect of poisoning the surface and reducing the H_2 adsorption. The form of the polarisation curve began to change when the As was less than 4×10^{-9} gm. Pt, heated for 10 sec. at 900° C., was found to combine with one atom of O per atom of Pt. After kathodic reduction, Pt was oxidised more rapidly in alkaline media than in neutral or acid. The adsorbed O_2 was a monatomic layer. Long heating at 900° resulted in the adsorption of O_2 in considerable amounts, corresponding to several atomic layers. The retention of the O_2 by the surface was also increased. F. J. B.

3114. Linear Adsorption on Two-Dimensional Colloids. P. F. Pochil, T. I. Silberman and D. L. Talmud. *Acta Physicochimica*, 8. 5. *pp.* 517–526, 1938. *In English.*—The monolayer of two-dimensional barium myristate colloid, previously stuided by the authors, was used as adsorbent for the quantitative measurement of linear adsorption. Dimethyl ester of tetradecane dicarbonic acid was used as linearly active substance, its surface concentration ensuring the gaseous state of the ester monolayer. The number of linearly adsorbed molecules of ester on the particles of the two-dimensional colloid was experimentally determined. The size of the particles of two-dimensional colloid, calculated from the curve of linear adsorption, has been shown to coinicide with the value obtained from the curve of the kinetics of formation of two-dimensional colloid. AUTHORS.

3115. Theory of Adsorption from Solutions. A. Schuchowitzky. *Acta Physicochimica*, 8. 5. *pp.* 531–548, 1938. *In English.*—A potential theory of adsorption from real solutions is formulated. It is shown that in general the experimental data follow the qualitative predictions of this theory. The discrepancies between the quantitative theory and experiment prove the inadequacy of the physical concepts of the Polanyi theory. A theory of adsorption from solutions is considered in the light of the Langmuir theory. It is shown that such a theory of adsorption from a perfect solution with $\gamma = 1$ gives the same results as the Polanyi theory. The disagreement between experiment and quantitative predictions of the potential theory is formulated. A hypothesis on the causes of this disagreement is advanced and discussed. AUTHOR.

3116. Adsorbability of Chain Molecules. A. Baum and E. Broda. *Faraday Soc., Trans.* 34. *pp.* 797–799, *July*, 1938.—The adsorbability generally grows with increasing chain-length of the molecules of the adsorptive, even if the adsorption heat is not considerable. The smaller adsorption velocity of long chain compounds, however, may cancel the effect of their greater adsorbability in equilibrium. AUTHORS.

3117. Surface Tensions of Liquid Crystals. A. Ferguson and S. J. Kennedy. *Phil. Mag.* 26. *pp.* 41–49, *July*, 1938.—A method is described for the measurement of surface tension over a wide range of temperature, in which a furnace of simple design is used. The method, which does not demand the use of more than a few mm^3. of liquid is applied to the determination of the surface tensions of anisaldazine, *p*-azoxyanisol, and *p*-azoxyphenetol. The results obtained cover the region which contains the transition temperatures. AUTHORS.

3118. Passivity of Metals and Surface Compounds. L. Lepin. *Acta Physicochimica*, 8. 5. *pp.* 660–668, 1938. *In English.*—Faraday's oxide film theory of passivity of metals is enlarged and it is shown that the phenomenon of passivity as well as the indifference of noble metals are due to the formation of surface compounds, namely, surface oxides of high valency, which render the metals inactive towards the oxidising agents. The ability to form surface compounds depends upon the position of metals in Mendeleeff's periodic system. The denser the space lattice of the metal is, *i.e.*, the less the atomic radius of the metal, the less able is it to take part in ordinary volume reactions and the easier will it be for it to participate in surface chemical actions. AUTHOR.

3119. Mechanism of Oxidation of Iron and Reduction of Iron Oxides. K. Endô. *Tôhoku Univ. Sci. Reports*, 11. *pp.* 562–591, *April*, 1938. *In English. Report No.* 437 *of the Research Inst. for Iron, Steel and Other Metals.* Regarding the progressive oxidations of $Fe \rightarrow FeO \rightarrow Fe_3O_4 \rightarrow Fe_2O_3$, and also the reductions of these oxides, the author investigated, by means of X-rays, the orientations of these products with respect to their parent substances and proposes mechanisms to explain these changes on the basis of the experimental results. AUTHOR.

3120. Electron Diffraction by Oxides of Antimony Formed on Stibnite. S. Miyake. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 788. *pp.* 565–583, *June*, 1938. *In English.*—The superficial formation of antimony oxides on a cleavage of stibnite (Sb_2S_3) upon heating in air was studied by means of electron diffraction. According to the heating conditions, three oxides were formed. Among these, Sb_2O_3 showed a perfect orientation of the crystal. The forbidden spots appearing in the pattern due to Sb_2O_3 are all explained by multiple reflection. The irrational spot of the Lassen type and the mesh pattern of the Cochrane type could be observed at proper azimuths. A spot pattern of a new type was also observed which could be satisfactorily explained as due to refraction by the developed surfaces of the diffracting small single crystal. These surfaces were found to correspond precisely to those, which are required by the theory of the crystal form factor of Laue in order to explain the irrational spot. By the use of this theory, the order of the crystal size was estimated. The mean inner potential of Sb_2O_3 deduced from the effect of refraction is 17 V. AUTHOR.

3121. Flow of Unimolecular Surface Films. E. R. Washburn and H. R. R. Wakeham. *Am. Chem. Soc., J.* 60. *pp.* 1294–1296, *June*, 1938.—The rate of flow of unimolecular surface films of stearic acid on water has been studied. Observations have been made regarding the effect of film pressure, temperature and H-ion concentration of the substrate water on the rate of flow. AUTHORS.

3122. Viscosity of Unimolecular Films. W. J. Moore, Jr., and H. Eyring. *J. Chem. Phys.* 6. *pp.* 391–394, *July*, 1938.—The equation for the fluidity of a liquid based on the reaction rate theory of viscous flow is modified to interpret the viscosity data for liquid films. The free energy of activation for viscous flow in the surface films, as calculated from the viscosity data of Harkins and Meyers, and Langmuir and Schafer, is found to be about twice that for flow in the liquid in bulk. This may be explained by the occurrence of various types of association in the liquid films, *e.g.*, lateral association of the surface molecules with one another and vertical association with the solvent (solvation of the polar groups). Equations are given for the pressure and temperature effect on surface viscosity. It is shown how the knowledge of these effects may be used to interpret the structure of the films, and to separate and evaluate the contributions to the free energy of activation due to lateral association, solvation and H bonds. AUTHORS.

3123. Electric Moment of Aliphatic Alcohols, Acids, and Esters at Cellulose and Aluminium Oxide Interfaces. M. A. Lauffer and R. A. Gortner. *J. Phys. Chem.* 42. *pp.* 641–656, *May*, 1938.—The electric moment of the double layer per sq. cm. was determined for a homologous series of alcohols (MeOH to *n*-heptanol) at Al_2O_3 interfaces, and for a similar series of fatty acids and esters at cellulose interfaces, using the streaming potential method. A new type of streaming cell was employed. It was found that the streaming potential was in all cases proportional to the pressure. The stages in the homologous series at which reversal of sign of the charge on the Al_2O_3 or cellulose surface took place were determined. They vary with the interface. [See Abstract 829 (1933).] A. J. M.

3124. Potentials of Built-Up Multilayers on Metals. J. J. Bikerman. *Faraday Soc., Trans.* 34. *pp.* 800–803, *July*, 1938.—A new type of built-up multilayers on metal is described. They are formed like the X films of Blodgett but possess a low potential. The natural X films give rise to high potentials which rapidly decay. The potentials at zero time are between pH 8·2 and 9·8 independent of the H- ion activity, although the film potentials on water change their sign within this range of pH. AUTHOR.

See also Abstracts 3064, 3068, 3069, 3222, 3318, 3379.

TIME.

3125. Programme Selection in Transit Observations. J. Schive. *Bull. géodésique, No.* 55. *pp.* 211–218, *July–Aug.–Sept.*, 1937. *In English.* —The results arrived at in several recent papers on the subject are embodied in a single principle of selection—the "extended balance-method." It is pointed out that although the ordinary balance-method for longitude determinations gives almost maximum weight to the element sought, no control is possible on the azimuth constancy of the instrument used. It is shown that with the method described such control can be established and more stable solutions obtained with only a slight loss of accuracy. A series of curves shows how balancing distances can be obtained from the conditions formulated, whether the element concerned is time, azimuth, or Laplace azimuth. Curves are also drawn exhibiting the accuracy obtained, and how it falls off when a better determination of the auxiliary elements is sought by selecting stars at a greater distance from the central point. It is claimed that the extended balance-method reduces this loss of accuracy to a minimum. A. Hu.

VISCOSITY AND FRICTION.

3126. Equation for Viscosity of Mixtures. S. K. Chakrabertty and P. B. Ganguly. *Nat. Acad. Sci. India, Proc.* 7. *pp.* 205–221, *Dec.*, 1937.—An expression of the form $\log \eta_{sol} - \frac{1}{3} \log \rho_{sol} = C_1 + C_2 x_2$ can be deduced from Andrade's equation for viscosity on the basis of certain assumptions. The applicability of the above equation has been tested by considering 18 binary systems. On plotting the value of log η_{mol} − $\frac{1}{3}$ log ρ_{mol} against x_2 the graphs have been found to be straight lines in many cases. In the case of systems, the components of which have polar properties and are dissimilar in nature, the divergence is marked. This is explained as due to loose compound formation. The viscosity values calculated from MacLeod's equation have been compared with those obtained from the above equation. The latter equation gives somewhat better values. AUTHORS.

3127. Internal Friction in Solids. Part V. General Theory of Macroscopic Eddy Currents. C. Zener. *Phys. Rev.* **53.** *pp.* 1010–1013, *June* 15, 1938.—In vibrating ferromagnetic metals macroscopic eddy currents tend to shield the interior of the metal from changes in magnetic induction. The dissipation of energy by these eddy currents contributes to the internal friction of the metal. This internal friction has previously been investigated theoretically only for longitudinal vibrations, and only the asymptotic formulæ for high and low frequencies have been found. In this paper this internal friction is calculated for all frequencies for both longitudinal and transverse vibrations. The theory of internal friction due to macroscopic eddy currents is shown to be formally identical with the theory of internal friction due to macroscopic thermal currents. The methods developed by the author for the study of thermoelastic internal friction are thus directly applicable to the study of the macroscopic electric eddy currents. [For Part IV see Abstract 1881 (1938).] AUTHOR.

See also Abstract 3122.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***3128. Schmidt Camera.** *Observatory*, 61. *pp.* 156–159, *June*, 1938.—A brief non-mathematical account is given of the nature and power of this important instrument. It is essentially an instrument for producing a wide-angle field of good definition even with small focal ratios. The camera employs as objective a spherical mirror, and to overcome the severe spherical aberration which would otherwise be encountered a plate is introduced at the centre of curvature which leaves the central rays falling on the mirror undisturbed whilst the outer ones are rendered slightly divergent. The quality of the results depends upon the figuring of the correcting plate, which is quite laborious. Good fields of up to 20° have been obtained. A. H.

***3129. Object-Glass Diaphragms in Photoelectric Stellar Photometry. M. Güssow.** *Zeits. f. Astrophysik*, 15. 5. *pp.* 361–362, 1938.—When diaphragms were used over the object-glass of the telescope to weaken stellar intensities, it was found that the apparent weakening for a given diaphragm was different for different photo-cells used, and also depended on the colour of the star. These effects are explained by non-uniformity of the photoelectric surface. [See also Abstract 2329 (1938).] D. H. F.

See also Abstract 3245.

COMETS AND METEORS.

3130. Photographs of Comet Finsler (1937 f). F. I. Blumbach. *Norman Lockyer Observat., Bull.* 1. *pp.* 7–10, *April,* 1938.—Photographs were taken on 12 nights between July 20 and Aug. 17, 1937, with the Mond photographic equatorial, mounting 4 all-metallic cameras, simultaneously, using all the time available as permitted by moon, clouds and twilight; the exposures ranging from 62 to 321 min. Reproductions of 5 negatives, and visual descriptions of the comet, as seen in the 4-in. guiding telescope, are given. A. S. D. M.

3131. Spectrum of Comet Finsler (1937f). D. R. Barber. *Norman Lockyer Observat., Bull.* 1. *pp.* 11–13, *April,* 1938.—Five spectrograms were obtained during July-Aug., with the McLean prismatic camera fitted with a 12-in. prism of 20° angle; the scale is 21·2 mm. between Hβ and Hδ, the dispersion being 32·7 Å per mm. at Hγ. A composite enlargement obtained by combining the two best exposures in the photographic and visual regions is reproduced. It shows the usual emission features of a cometary spectrum; the continuous spectrum is cut off abruptly to the violet of the CN band, λ3862. Relative intensity measures are at variance with Minkowski's, and with Aller's results; explanations of this variance are discussed. No spectral image of a cometary tail is found. A list is given of the identified emission features, together with their wave-lengths, observed band limits and probable origin. A. S. D. M.

3132. Spectrum of Cometary Nuclei and Bands of Molecule CH. J. Dufay. *Comptes Rendus,* 206. *pp.* 1550–1553, *May* 23, 1938.—The author confirms Nicolet's research [see Abstract 1886 (1938)]. He finds, also, that the Lyons Observatory measures establish definitely the presence of H in comets. A table of wave-lengths, 4290 4340 Å is given for comets Peltier, Finsler, Encke, Whipple and Wilk, and these radiations may be interpreted as means between the bands, 0 → 0 and 1 → 1 of the system A → X of CH, except for 4319 Å which, he says, is near a band A → X of the molecule N^2 [see Abstract 1975 (1937)]. No origin has yet been found for 4050 Å, in cometary nuclei [see Abstract 115 (1937)]. He suggests, however, that the radiation near 4050 may be due to the molecule CH when passing from a higher level (still unknown but perhaps metastable) to a normal state $X^2\Pi$. A. S. D. M.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

3133. Periodic Solutions in the Restricted Problem of Three Bodies. T. Uno. *Japanese Journ. Astron. & Geophys.* 15. 1–2. *pp.* 149–191, 1938. *In French.*—The existence of periodic solutions is discussed in the restricted problem of three bodies, assuming that the mass of the second body is relatively small. G. C. McV.

3134. Periodic Motion in Celestial Mechanics, and the Variation of Orbital Elements. Part II. H. Fabre. *Bull. Astronomique,* 11. 1–2. *pp.* 17–136, 1938.—In Part II the author takes an example of the substitution of absolute orbits for real orbits and shows that the longitude of a node on the equatorial plane can be expressed as the sum of a linear term in the time t and a quasi-periodic function of t of two fundamental frequencies. For fields of force having an axis of revolution and an equator, the existence of long-period solutions for the equations of relative motion in the meridian plane is established. The motion of the line of apsides is investigated for cases where the orbit is described outside the attracting mass, and where, as in Saturn's rings or stellar clusters, the trajectory is amid attracting masses. The results are extended to cover the investigation of the secular displacement of the line of apsides when the orbital inclination is large. The properties characteristic of the most general absolute orbits are discussed, but the number of fundamental frequencies possible remains uncertain. Finally, the modifications introduced into the orbital variations by making the perturbing potential a periodic function of t are considered. [For Part I see Abstract 2753 (1938).]

A. Hu.

LATITUDE AND LONGITUDE.

See Abstracts 3125, 3419.

NEBULÆ.

3135. Survey of 16,639 Galaxies North of Declination + 70°. H. Shapley and R. B. Jones. *Harvard Coll. Obs., Ann.* 106. 1. *pp.* 1–38, 1938.—An examination of 52 3-hr. exposure plates made with the 16-in. Metcalf doublet at Oak Ridge has yielded over 16000 galaxies brighter than the 18th magnitude, and calls attention to the wide-spread irregular space absorption that covers the North Polar Cap. Star counts for the area north of declination + 80° are used to verify the existence of absorbing clouds near the North Pole. Photographic magnitudes of all galaxies have been determined with reference to sequences of stellar magnitudes set up on the individual plates by the star-count method. The published arrays (magnitude distribution in each square degree) contain some duplication through overlapping plates; but in the distribution charts allowance has been made for such duplication. Only two conspicuous groups of galaxies are noted, each having a population of about 100 to the magnitude limit of the plate involved. Other departures from uniformity in distribution may be real, in the highest galactic latitudes concerned, but projected analyses of star distribution in this region may connect most of such irregularities in nebular density with irregularities in space absorption.

AUTHORS.

3136. Inclinations of Spiral Nebulæ to the Line of Sight. H. Knox-Shaw. *Roy. Astron. Soc., M.N.* 98. *pp.* 587–588, *May,* 1938.—The frequency of apparent ellipticities of the spirals down to 2′ in dia. in the Shapley-Ames catalogue is such as would be expected from a random distribution of their planes.

AUTHOR.

3137. Physical Processes in Gaseous Nebulæ. Part III. Balmer Decrement. J. G. Baker and D. H. Menzel. *Astrophys. J.* 88. *pp.* 52–64, *July,* 1938.—This paper contains a numerical solution of the equations derived and formally solved in two earlier papers of the series. Various tables of general interest, including those of functions $X_n = hR/n^2kT\epsilon$ and $-[Ei(-X_n)]$, for useful astrophysical ranges of n and $T\epsilon$ are given. The Balmer decrement, computed under two alternative hypotheses—A for a nebula transparent to Lyman line radiation, and B for an opaque nebula—is tabulated. The latter hypothesis agrees better with the observed data. The conclusion is reached that the electron temperature, $T\epsilon$, of the nebular gas cannot be effectively determined from observed Balmer decrement data, because the decrement is insensitive to temperature. In view of the extreme physical conditions that exist in nebulæ, the partition of atoms among the various excited levels approaches surprisingly close to the thermodynamic value. [For Part II see Abstract 3442 (1937).]

AUTHORS.

PLANETS.

3138. Origin of the Planets. R. A. Lyttleton. *Roy. Astron. Soc., M.N.* 98. *pp.* 536–543, *May*, 1938.—In considering the binary hypothesis of the origin of the solar system three factors are more important than the mere disruption of the binary star. Luyten and Hill have drawn attention to the energy required to remove material from the surface of a star. But in addition it turns out that any material which escaped after a collision would have a velocity nearer to that of the smaller of the stars involved, and furthermore the change in the velocity of the sun must be taken into account. The first contingency requires energy to be supplied by the intruding star and is thus a restriction on the encounter; but the second and third factors enable the planets to have small velocity relative to the sun under suitable initial conditions. It appears that the encounter is most likely to be effective when the mass of the third star is greater than that of the companion of the sun. Nothing approaching exactness can be attained in discussing the motion, but it seems entirely possible for the binary hypothesis to give a satisfactory basis for a theory. AUTHOR.

3139. Criterion for Identification of Minor Planets. B. de Jekhowsky. *Comptes Rendus*, 206. *pp.* 1361–1364, *May* 9, 1938.—The identification of a minor planet by fitting a single recent observation of it with the predicted ephemeris of an old asteroid usually presents difficulty. Picart's criterion, published in 1915, in which the orbital elements are combined with the observed geocentric coordinates and their derivatives, has not often been used because of the intricacy of the auxiliary computation it demands. The criterion is simplified by being put into determinant form and by changing the reference axes. A. Hu.

3140. Geophysical Lunar Almanac. J. Bartels and G. Fanselau. *Terr. Mag.* 43. *pp.* 155–158, *June*, 1938.—The astronomical year-books furnish complete data for the motion of the apparent moon from day to day. Those tables, which so far have had no counterpart for the *mean* moon, are frequently, because of their convenience, used as a basis for geophysical computations on lunar effects. Thereby, however, the connection is lost with the harmonic analysis of the tidal forces, which is based on the mean moon; furthermore, the unequal length of the apparent lunar day is troublesome in the computations. Adolf Schmidt has introduced magnitudes μ, $(\pi + \mu)$, and $(\rho + \mu)$, which, in suitable form, indicate the phase of the mean moon and its distance from mean perigee and from the mean ascending node of the moon's orbit. Tables are given here for these magnitudes, from which they can be read easily for each day of the years 1850 to 1975. The differences between the motions of the apparent and mean moon are illustrated by extreme cases. AUTHORS.

3141. Photovisual Investigation of the Brightness of 59 Areas on the Moon. A. L. Bennett. *Astrophys. J.* 88. *pp.* 1–26, *July*, 1938. —The brightness, on a uniform scale, of 59 areas on the surface of the moon, at eleven phase angles, was determined photovisually from plates taken at the Lowell Observatory. It was found that the variation of brightness is similar for all the areas and depends strongly on the angle of reflection as well as on the azimuth between the incident and the reflected rays. On the assumptions that the surface is pitted with spheroidal cups whose contribution to the brightness is proportional to the projected area of the visible illuminated surface, and that the surface between the cups is plane and that its brightness follows Lambert's law, it is possible to represent the observed variation for small angles of reflection. When the angle of reflection is great, the computed brightness is a maximum for normal incidence and not at full moon as observed. There is, however, a large dependence of the brightness on the azimuth. AUTHOR.

See also Abstracts 3134, 3180, 3181.

STARS.

3142. Distribution of Stars in the Cape Astrographic Zone, − 40° to − 52°. J. Jackson. *Roy. Astron. Soc., M.N.* 98. *pp.* 491–517, *May,* 1938.

3143. New Method of Differential Measures of Proper Motions. J. Clavier. *Bull. Astronomique,* 11. 1–2. *pp.* 1–15, 1938.—The author reviews the methods used by Schlesinger, Kreiken, Trumpler, Paloque, van Rhyn and Raimond ; their several advantages and probable errors. For the differential measurement of proper motions in the photographic catalogue actually under study in Paris by Baillaud, she proposes a method in which the new plate, intended for comparison with the corresponding old one, is photographed under the same conditions as this had been. A positive is got by contact with each of the two plates, and on the same sensitive plate is taken a contratype of each of the two positives ; care being taken to shift slightly one of the positives with respect to the other, thus obtaining on a single negative reproductions of the two plates of the same region at distant dates. The images are thus indissolubly related ; they are on the same plane ; there is no risk of disturbance in the passage of light from one plate to another. Enquiry has been made into all possible defects introduced by this method, and the results are found to be satisfactory. A. S. D. M.

3144. Photographic Deduction of the Proper Motions of Stars. G. Bemporad and A. M. Vergnano. *Accad. Sci. Torino, Atti,* 73. *Disp.* 2*a*. *pp.* 274–289, *Jan.–March,* 1938.—The authors have developed a method of determining the positions of a star from two photographs taken at different times, with the help of three or more reference stars. If the reference stars are known to have no proper motion, the proper motion of the star under question can be determined. The authors carry out a detailed calculation of the positions of the two stars B.D. 49° 3937 and B.D. + 48° 3390 from a photograph taken at Catania in 1900 and one taken at Torino in 1937. They find that B.D. 49° 3937 has a definite though not exceptionally great proper motion ($\mu_\alpha \cos \delta = + 0{\cdot}184''$, $\mu_\delta = - 0{\cdot}031''$), while the proper motion expected for B.D. + 48° 3390, could not be confirmed. L. K.

3145. Constants of Star-Streams from Photographic Proper Motions of 1775 Stars. W. M. Smart and T. R. Tannahill. *Roy. Astron. Soc., M.N.* 98. *pp.* 563–570, *May,* 1938.—The photographic proper motions of 1775 stars determined from Cambridge plates have been analysed according to the two-streams theory by Eddington's method. The drift-constants have been derived and the principal results are : Position of vertex, in galactic coordinates : (337°, − 1°·4). Position of solar apex, in equatorial coordinates : (261°·1, + 42°·5). AUTHORS.

3146. Analysis of the K Term in B-Type Stars. J. S. Plaskett. *Roy. Astron. Soc., M.N.* 98. *pp.* 518–527, *May,* 1938.—The explanation of the *K* term involving a correction for supposed stream motion [see Abstracts 3087 and 3549 (1936)] is admitted to be in error, and the early solutions and some new ones are reviewed. The old corrected solutions, however, give

much more probable values of the solar motion and galactic rotation than the new, and reduce the previous high value of the K term to the probable value of the gravitational shift, whereas the new solutions of the observed uncorrected values give rise to many anomalies. The introduction of galactic rotation terms has no practical effect on the K term, but tends to reduce the value of the solar velocity obtained from B-stars into better agreement with that from stars of all spectral types. The high value of K arises principally from the brighter B3 — B7 southern stars between longitudes 210° and 330°. If the large outward motion of these stars is allowed for, the K term is reduced sufficiently close to the gravitational shift to justify the claim that the cause of its high value has been found.
A. Hu.

3147. Proper Motions in Fields of Stars with Large Motion. A. van Maanen. *Mt. Wilson Observat., Contrib. No.* 592. *Astrophys. J.* 88. *pp.* 27–33, *July,* 1938.—By superposing photographs, taken at intervals ranging from 10 to 23 years, 105 stars showing a decided proper motion were found in 223 fields in which the central stars had a motion of about 0″·5 or more annually. 16 of these stars are companions of the central stars; for all these the parallax is known. The distances from the central stars range from100 to 10000 astronomical units, the absolute photographic magnitudes from + 10·1 to + 14·0 with a maximum frequency at about + 12.
AUTHOR.

3148. Radial Velocities of 600 Stars and Measures of 69 Spectroscopic Binaries. W. H. Christie and O. C. Wilson. *Mt. Wilson Observat., Contrib. No.* 593. *Astrophys. J.* 88. *pp.* 34–51, *July,* 1938.—The radial velocities of 600 stars observed with the 60- and 100-in. reflectors are given. This list is in no way homogeneous and contains stars from several observing lists made up for various investigations. In addition, measures are given for 69 variable-velocity stars, some of which have been observed elsewhere.
AUTHORS.

3149. Multiplet Calibration of the Arcturus Spectrum. S. G. Hacker. *Astrophys. J.* 88. *pp.* 65–83, *July,* 1938.—An independent multiplet calibration of the writer's intensity scale of the Arcturus spectrum ($\lambda\lambda$ 4119–6743) is effected after the method used by Russell, Adams, and Moore in their calibration of Rowland's solar intensities. Certain data of astrophysical importance about the atmosphere of the star are then obtained from the atomic lines identified in its spectrum. The calibration of the intensity scale is given in a table. Its reliability is examined and the errors involved in the calibration are discussed. Assuming the stellar atmosphere to be in thermodynamic equilibrium, the linear relationship between $Y = \log (N'_x/N_x)$ and E_x demanded by equation (1) stated in the paper represents the data satisfactorily; the "quadratic effect" found by Adams and Russell is not observed. The corresponding lines for the 7 best represented elements are shown in a diagram. Their slopes, S, were found by least-squares solutions from the data given and the weighted mean slope gives 3925° ± 75° K. as the effective photospheric temperature of Arcturus, taking the sun's as 5740° K. The mean electron pressure in the star's atmosphere is found to be $3\cdot9 \times 10^{-8}$ atm., and the "level of ionisation" is 7·7 volts. Incidentally, with the values used in this paper, the degree of ionisation in the sunspot corresponds roughly to the mean between that in the solar disc and in Arcturus, decreased by a factor of 1/12. For the sake of completeness, the relative abundance of the atoms of different elements present in the star is indicated in tables.
AUTHOR.

3150. Excitation of Absorption Lines in Outer Atmospheric Shells of Stars. O. Struve and K. Wurm. *Astrophys. J.* 88. *pp.* 84–109, *July,* 1938.—The He I lines show abnormal intensities in the outer shells of peculiar B stars. In ζ Tauri and φ Persei He I λ 3965 (2^1S-4^1P) is narrow and sharp, while all lines arising from the levels 2^1P and 2^3P are broad and diffuse. This is attributed to the dilution of the radiation from the B star in the shell. The anomalous intensities of He I are investigated in the entire sequence of B stars having outer shells. The theory of the excitation of absorption lines in a field of diluted radiation is developed and applied to six levels of He I : 1^1S, 2^1S, 2^1P, 2^3S, 2^3P, and the state of ionisation. The populations in the various states have been computed for dilution factors 0·1, 0·02, and 0·01, and for temperatures of 10^4 and $2{\cdot}5 \times 10^4$ degrees. The theoretical populations for a dilution factor of the order of 0·01 agree with the observations. Accordingly, the radius of the shell is approximately five times the radius of the star. The entire He I anomaly is accounted for by the theory. The absence of rotational broadening in lines produced in the shells shows that these shells do not rotate as solid bodies with the photospheres. The latter are rotating rapidly in most of the stars investigated. Some lines, such as Si II in ζ Tauri, show broadening intermediate between the normal He I lines in the deepest layers and the λ 3965 line of He I in the shell. Hence, the elements are stratified. The ionisation decreases outward in all stars investigated except β Lyræ. The strength of the H cores in the shells is explained by the metastability of the 2S-level. The weakness of Mg II 4481 is explained by the fact that the lower level has strong transitions downward. The He I anomaly in ordinary giants and dwarfs of class B bears a strong resemblance to the anomaly in the shells. The explanation is doubtless similar, but there are complications due to Stark effect, collisional damping, etc. AUTHORS.

3151. Thermal Agitation in the Presence of a Gravitational Field. E. Sevin. *Comptes Rendus,* 206. *pp.* 1621–1623, *May* 30, 1938.—The pressure, p, in a monatomic stellar gaseous atmosphere is shown to be related to the density, ρ, by the equation $p = k\rho^{4/3}$ where k is a constant. The result corresponds exactly with that relating to the state of so-called polytropic equilibrium for the case $n = 3$. A star even if composed of neutrons cannot lose heat by conduction. J. S. G. T.

3152. Stability of Convective Stars. T. G. Cowling. *Roy. Astron. Soc., M.N.* 98. *pp.* 528–535, *May,* 1938.—It is shown how to determine boundary conditions for a star which is in convective equilibrium up to the photosphere : these boundary conditions determine its radius. Conditions of secular and vibrational stability are found for a special model : these are jointly satisfied only when the law of generation of energy lies in a rather restricted range. AUTHOR.

3153. Existence of Stellar Systems in a Quasi-Steady State of Motion. B. Lindblad. *Roy. Astron. Soc., M.N.* 98. *pp.* 576–586, *May,* 1938.—The general existence of steady states of motion of the Poincaré-Jeans type is shown. In addition to symmetry of rotation, systems in these states must possess symmetry with respect to the invariable plane. In the case of steady three-axial ellipsoidal distributions the consequences of Poisson's equation for the character of the differential rotation and for the ratio of the axes in the galactic plane are demonstrated, and it is concluded that such distributions are valid only for limited intervals of the distance from the centre. The meaning in the present case of the term steady or quasi-steady state is discussed. AUTHOR.

3154. Form of Rotating-Gas Configurations. Part II. Z. Kopal. *Roy. Astron. Soc., M.N.* 98. *pp.* 589–597, *May,* 1938.—The problem dealt with in the present paper may be stated as follows. Suppose we have a slowly rotating gaseous configuration with the density decreasing monotonically from the centre to the surface, which in consequence of its rotation becomes oblate. Now change the whole march of the density distribution in such a way that it will exhibit a reversal of the density gradient, and the maximal density will not be attained at the centre, but at a certain fraction of the radius. What will be the effect of the reversal on the oblateness compared with that of the initial configuration ? In order to be able to give a general answer, the calculations have been carried out for two models (with central density finite or zero) in detail, and it was found that the effect of the reversal is generally small, even if it is exhibited at a considerable fraction of the radius. The oblatenesses of such configurations are very nearly the same as those of configurations with the same degree of density condensation, but possessing a negative density gradient throughout. [For Part I see Abstract 2340 (1938).] AUTHOR.

3155. Mass-Luminosity Law and Tidal Deformation of Stars. K. Walter. *Zeits. f. Astrophysik,* 15. 5. *pp.* 315–341, 1938.—The 51 binary systems for which the H content can be calculated by Strömgren's method [see Abstract 4804 (1933)] are studied with a view to determining the connection between tidal deformation and H content. It appears that tidally deformed main series stars of masses greater than 1·8 ⊙ show a systematic H defect of 20% as compared with negligibly deformed stars. This is attributed to a luminosity effect associated with tidal deformation. The alterations to the mass-luminosity law, taking this effect into account, are discussed. It is also shown that the calculation of the radii of main series stars is affected by tidal deformation particularly for stars of masses near 2·5 ⊙. G. C. McV.

3156. Gravitational Potential of the Galaxy. H. Mineur. *Comptes Rendus,* 206. *pp.* 1618–1620, *May* 30, 1938.—A quadratic expression for the potential of the universe at a point in the galactic plane is developed. The conclusion of Bok [see Abstract 3695 (1930)] that the coefficient of ξ^2 in such an expression (ξ being the coordinate towards the anticentre) is negative if the stellar density decreases away from the galactic centre is challenged. A homogeneous cylinder or a succession of such cylinders superposed coaxially may obey the condition though the coefficient concerned be positive near the centre. A galactic model may however be postulated in which the coefficient is everywhere negative. It is shown that this condition holds for a homogeneous ellipsoid of revolution, and thence for a number of such ellipsoids superposed concentrically. The numerical values of the coefficients of the quadratic are deduced from observational results on the variation of stellar density with distance from the galactic centre, and on the coefficients A, B, and C of galactic rotation obtained from the author's study of the motion of open clusters. [See Abstract 108 (1938).] A. Hu.

3157. Observations by American Association of Variable Star Observers. L. Campbell. *Harvard Coll. Obs., Ann.* 104. 8. *pp.* 239–278, 1938. [See also Abstract 1527 (1938).].

3158. Discovery of a Quintuple Star. A. Bemporad. *Ricerca Scientifica*, 9. *pp.* 414–415, *May*, 1938.—In the course of a revision of the star catalogue of Catania, the author found a quintuple star on the plates No. 752 and No. 1810 taken on Aug. 29, 1898, and Sept. 10, 1902, respectively with 5 to 6 min. exposure. The R.A. and declination of the five stars are given together with the angular separation and the position angle. It is proposed to take a photograph of the same region with 10 min. exposure in order to obtain better data of the positions of the stars. L. K.

3159. Rotational Effect in Eclipsing Binaries and Stellar Dimensions. R. M. Petrie. *Roy. Astron. Soc. Canada, J.* 32. *pp.* 257–261, *May–June*, 1938.—The sequence of variation of light in eclipsing binaries is described, and their radial velocities show a peculiar effect, illustrated by a figure of RZ Cassiopeiæ. Before mid-eclipse these are too positive; after it, too negative. The author attributes this effect to the rotation on its axis of the smaller but brighter star, and by means of this "rotation effect," combined with the photometric and spectroscopic data, the deviations and absolute dimensions of the binary system may be determined. For the brighter and darker components of RZ Cass., he finds: orbital radii, 1,172,000 km. and 6,485,000 km.; masses 10·3 and 1·9 ⊙; mean densities 0·94 and 0·08 (water). A. S. D. M.

3160. Epsilon Aurigæ. O. Struve and H. B. Lemon. *Am. Phys. Teacher*, 6. *pp.* 123–132, *June*, 1938.—The history of our knowledge of this long-period variable star is presented in semi-popular style. [See Abstract 535 (1938).] A. Hu.

See also Abstracts 3129, 3138.

SUN.

3161. Sunspot Activity and the Form of the Solar Corona. W. E. Bernheimer. *Roy. Astron. Soc., M.N.* 98. *pp.* 598–604, *May*, 1938. —The discussion of all available eclipse data indicates that the alterations in the shape of the solar corona take place in the rhythm of the yearly means of the sunspot activity, with a positive displacement of 4 months. Thus they have a distinct gradual character. It seems that all other hypotheses must be abandoned, whether they refer to displacements in a negative direction, or whether they assume alterations of the corona-form in the rhythm of the simultaneous sunspot situation or of their monthly means. Besides the general gradual changes of the corona-form there exist doubtless also sudden and short-lived changes which appear to be associated with sudden outbreaks of prominences or flocculi. AUTHOR.

3162. Molecular Carbon in the Solar Spectrum. M. G. Adam. *Roy. Astron. Soc., M.N.* 98. *pp.* 544–562, *May*, 1938.—Wave-lengths and equivalent widths are obtained for all measurable unblended lines of R.I. 0, − 1, − 2 and − 3 in the region λλ 5070–5160 Å of the solar spectrum at centre and limb; all those attributed to carbon or otherwise unidentified are listed. By a comparison with the laboratory carbon spectrum, 37 Swan band lines are identified in the centre spectra and 33 in the limb. The molecular lines are shown to have a thermal distribution of intensity. From the intensity variation excitation temperatures of 4550° K. at the centre and 4790° K. at the limb are obtained. The comparatively high limb temperature is confirmed by an alternative method of calculation from the observed intensities. AUTHOR.

See also Abstract 3186.

GEOPHYSICS.

GEODESY.

3163. Figure of the Earth. N. E. Nörlund. *Bull. géodésique, No.* 55. *pp.* 193–210, *July–Aug.–Sept.*, 1937. *In English.*—The paper consists largely of a historical survey regarding triangulation, the form of the geoid and spheroid, the deflection of the vertical, isostatic compensation, and gravity measurements. The theories of Airy, Platt and Meinesz for isostatic compensation are discussed and finally the existing problems in determining the geoid are mentioned. R. S. R.

GEOPHYSICS, APPLIED.

See Abstracts 3072, 3073, and
2527B. Spark Geology. Part VI. V. Fritsch.

HYDROSPHERE, PHYSICS OF THE.

3164. Temperature of Surface Water of Western North Atlantic. G. Slocum. *Monthly Weather Rev.* 66. *pp.* 39–43, *Feb.*, 1938.—The investigation deals with observations during the period 1912–1931 spread throughout the year, and made in a region including the Gulf of Mexico, the Caribbean Sea and the east coast of North America. The methods of observing are described, and the distribution of the observations discussed. Charts of the isotherms have been drawn, one for each of the 12 months. These are reproduced and also charts showing the annual range, the coolest and the warmest months of the year. The steep temperature gradient north of the Gulf Stream axis is referred to and the interchange of heat between the air and the surface water in the Gulf Stream examined in more detail. A line diagram gives the normal, extreme highest and lowest monthly temperatures for an area off the Virginia-Carolina capes. This shows that the seasonal normal temperature is a good measure of the actual temperature at any given line. The desirability of fuller information especially inshore and outside the area covered by the important steamer lanes is stressed. A. E. M. G.

3165. Ocean Waves. K. Hidaka. *Imp. Marine Obs., Kobe, Japan, Mem.* 6. *pp.* 337–347, *March*, 1938. *In English.*—The results are given of observations of ocean waves made by means of Froude's apparatus and kinematograph together with the results of subsequent computations necessary in order to separate the period of wind waves from that of swells. The Froude apparatus floated on the sea and its scale was read from the negative of the film, the motion of the sea surface being plotted against time. R. S. R.

3166. Marine Surveying. G. T. Rudé. *Am. Phil. Soc., Proc.* 79. 1. *pp.* 9–25, 1938.—The paper outlines recent progress in marine surveying around the coasts of the U.S.A. and possessions. A description is given of the Dorsey fathometer used for echo depth sounding, and of various modified forms of radio acoustic ranging for locating the survey vessel. The depths are rapidly plotted in relation to the positions obtained from the sono-radio-buoys. The latter contain small radio transmitters "keyed" by a hydrophone which receives the underwater explosive signal. A recorder on the survey vessel records the instant of explosion of an underwater bomb, and the arrival of the explosion at the sono-radio-buoys. During five months of the summer of 1937, one survey ship covered an area in the Gulf of Mexico of 6,513 sq. miles. Within the past six years 285,000 sq. miles of marine surveys have been made of the coastal waters of the U.S.A. and possessions. A. B. W.

See also Abstracts 3183, 3185.

LAND, PHYSICS OF THE.

3167. New Theory of Earth's Core. J. Lynch. *Roy. Astron. Soc. Canada, J.* 32. *pp.* 262–263, *May–June*, 1938.—It has been proved from seismical reflections and refractions that there is a core, about half-way towards the earth's centre; and the author discusses the amount of its rigidity. It has been generally assumed that if a shear-wave does not penetrate the core, it is fluid, but several recent investigations indicate that the shear-wave does pass through the core. He discusses, (1) the conditions under which a liquid core will transmit a shear-wave, (2) a core, solid but less rigid than the crust, and (3) the case of neither a liquid nor solid core, but a "solid solution—a metal heavily occluded with a gas," that is a metallic sponge. He illustrates his argument by an experiment with a Pd-torsion-pendulum, occluded with H_2 which greatly reduces its rigidity. A. S. D M.

3168. Natural Residual Magnetism of Eruptive Rocks. Part I. J. G. Koenigsberger. *Terr. Mag.* 43. *pp.* 119–130, *June*, 1938.—A connected summary with 155 references of the facts and theories—physical, chemical, mineralogical and petrographical—regarding the magnetic behaviour of eruptive rocks under the influence of the earth's magnetic field and of time; with special reference to the possibility of tracing change in direction of terrestrial magnetism and the time at which such changes occur, and of hence determining the age of the rocks concerned, or *vice versa*. C. A. S.

3169. Clay. W. H. Bragg. *Roy. Inst., Proc.* 30. ~~1.~~ *pp.* 39–67, 1938.—A review of recent researches into the plasticity, base-exchange, water-absorption, and other properties of clays by X-ray methods. The properties of silica, brucite, pyrophyllite, and other minerals are explained by reference to their atomic arrangements. R. F. A.

See also Abstract 3185.

METEOROLOGY.

3170. Thermodynamic Interpretation of Isentropic Charts. H. R. Byers. *Monthly Weather Rev.* 66. *pp.* 63–68, *March*, 1938.—The method of plotting and uses of isentropic charts are explained. Definitions of the quantities used are given and various derivations are obtained. Examples are given of the use of charts with actual and condensation pressures. The uses of cross-section charts of the atmosphere for altitude and distance are illustrated. It is concluded that the thermodynamic isentropic chart has the following advantages over the chart based on elevation and specific humidity, (1) better representation of significant moisture differences at low values, (2) nearness to condensation can be determined by the "condensation ratio" p_0/p directly from the chart and especially by noting on the chart a p_0-isobar and a p-isobar of equal value, (3) areas of saturation are indicated directly, (4) method of indicating the flow under saturated adiabatic conditions provided, (5) isotherms can be indicated easily, a given temperature being everywhere at the same pressure, (6) the weight of air in the layers between isentropic surfaces read off immediately, (7) cold lows appear as regions of greater activity and warm highs as regions less active than on other types of charts, and (8) the greater ease of preparation. R. S. R.

3171. Pressure Tendencies in Cyclones and Fronts. W. R. Stevens. *Monthly Weather Rev.* 66. *pp.* 68–70, *March*, 1938.—To illustrate the value of pressure tendencies in analysis and prognosis a set of model travelling depressions has been prepared. Each shows the depression at the time of observation and three hours previously with attendant pressure changes and characteristics. The systems considered are (1) a depression with warm sector and warm and cold fronts retaining the same positions relative to the moving system, (2) depression without frontal structure and no change in intensity, (3) a deepening depression with warm sector, and warm and cold fronts in unchanged relative positions, and (4) a deepening but rapidly occluding depression. The use of isallobaric charts to estimate the deepening and travel of depressions is discussed. R. S. R.

3172. Period of 5·25 Years in Rainfall, Temperature and Pressure. H. J. de Boer. *K. Akad. Amsterdam, Proc.* 41. 5. *pp.* 505–512, 1938.—Cold winters in 1924, 1929, 1934 over the Netherlands together with a periodicity of just over 5 yr. as found by Brooks in the N. and E. component of wind direction over the British Isles led to the detection of this 5·25 yr. period. The method of determining the period is explained. In this computation a quantity " the sign coefficient " is introduced thus avoiding the elaborate calculations of correlation coefficients. The scheme is first applied to seasonal temperature deviations at De Bilt for the period 1849–1938 and a 5·25 yr. period found. The stability of the period is tested and found to be satisfactory. The method is next applied to precipitation with similar results. An investigation of the character of the period on the North Atlantic shows (1) a phase difference combined with a decrease of amplitude on the Atlantic in the direction of the Gulf Stream, (2) a retardation at Thorshaven. These points are examined in detail. The third element investigated is air pressure. For this purpose pressure and temperature at Edinburgh for the period 1770–1930 are examined and compared with temperature results found for Zwanenburg and De Bilt. The conclusions arrived at are stated and numerical results tabulated. A. E. M. G.

3173. Transatlantic Aviation and Meteorology. P. D. MacTaggart-Cowan. *Roy. Astron. Soc. Canada, J.* 32. *pp.* 217–231, *May–June*, 1938.—A clear account of the preparations carried out previous to June, 1937, in connection with the Atlantic crossings by flying boats is set out. This includes choice of stations, wireless installations and operations, together with pioneer work of the meteorological staffs. The work done during the flights from June to Sept. is described in its various branches. The importance of meteorology to these flights is particularly stressed. The difference in behaviour of the different types of front and the rapid changes at different fronts show the need for very frequent observations These rapid changes are illustrated by chart. In the author's opinion much has yet to be done before a successful passenger service can be contemplated. A. E. M. G.

3174. Artificial Production of Snow Crystals. M. Perutz. *Nature*, 142. *pp.* 10–12, *July* 2, 1938.—In this article the recent work of U. Nakaya on snow crystals is summarised and discussed. Nakaya assumes that if the laws governing the development of a crystal can be established we can infer the physical state of its environment during condensation and its subsequent movements. A description is given of the apparatus used in the investigation. The growth of the crystal is found to consist of (*a*) the formation of the germ, (*b*) the subsequent development. The type of germ is found to influence the final shape, however radically conditions are altered in the second stage. Twelve types of the early stage are illustrated and a record of their history is given in tabular form. Rate of growth is characteristic of each type and serves as a qualitative measure of the degree of supersaturation. Some of the results of measurements of rates of growth in the second stage made with considerable accuracy, are recorded. A. E. M. G.

3175. Ice Ages. G. C. Simpson. *Roy. Inst., Proc.* 30. 1. *pp.* 125–142, 1938.—Following brief references to other evidences of climate the author affirms that " of all evidences of climate those of ice are the most unmistakeable." Short references are made to the pre-Cambrian and permo-carboniferous ice ages. The author thereafter proceeds to discuss in more detail the conditions during the pleistocene period. The conditions in the Alps during this period as revealed by the work of Penck and Brückner may be considered as representative of conditions generally. The climatic conditions in that age must therefore have been a sequence of glacial and interglacial epochs. The characteristics of these epochs are discussed. The cause of the ice age is next carefully considered. Here the author has been able to show that the ice age is caused not by a decrease of solar radiation but by an increase. He considers that if the theory is correct we are meantime in a cold dry epoch. A. E. M. G.

3176. Halo at Surface of Snow. A. Renaud. *Comptes Rendus,* 206. *pp.* 1750–1752, *June* 8, 1938.—A halo observed at the surface of snow at Jura at an altitude of 1466 m. on Nov. 14, 1937, is described. W. R. A.

3177. Atmospheric Sodium. J. Cabannes, J. Dufay and J. Gauzit. *Comptes Rendus,* 206. *pp.* 1525–1528, *May* 23, 1938.—Previous results are given more definitely and amplified. The relative intensities of the two components of the doublet are $D_1/D_2 = 1/2$. The height of the luminescent layer is about 130 km. The frequency of the transitions $^2P \rightarrow {}^2S$ is 2×10^{11}. The atmospheric Na is supposed to be of cosmic origin and probably from meteoric swarms. There are also indications of Ca and Al in the radiation of the night sky. [See Abstracts 1094 and 2799 (1938).]. R. S. R.

3178. Brightness of Twilight Sky and Density and Temperature of Atmosphere. E. O. Hulburt. *J.O.S.A.* 28. *pp.* 227–236, *July,* 1938. —With a calibrated Macbeth illuminometer measurements were made of i_z the brightness of the zenith sky and of i_v the energy flux across a vertical plane from the twilight horizon for the depression θ of the sun below the horizon from 0° to 13°. For clear sky conditions the i_z, θ and i_v, θ curves did not change within 30% with the season from Oct. 1937, to April, 1938, and were the same for evening and morning twilight. Calculation from the Rayleigh theory of molecular scattering and the observed i_z and i_v data showed that within ±30% the densities of the atmosphere from sea level to about 60 km. were those of the density-height relation known to 20 km. and extrapolated for a temperature of 218° K. It follows that the temperature of the twilight zone atmosphere is 218° ± 15° K. from 20 to 60 km. The influence of secondary scattering, determined from i_v, although small for small values of θ increased rapidly with θ to such an extent that the

twilight zenith sky brightness measures gave no indication of the distribution of density above about 60 km. [See also Abstract 125 (1938).]
AUTHOR.

✱3179. Electric Hygrometer and its Application. F. W. Dunmore. *Bureau of Standards, J. of Research,* 20. *pp.* 723–744, *June,* 1938. —Here the development of the electric hygrometer which has no appreciable lag and which thus renders possible a more rapid rate of ascent and humidity measurements at greater heights, is dealt with. The method of operation of the apparatus, the resistance portion of which consists of a double coil of wire wound on thin walled glass tubing, is explained. Considerable attention is given to the characteristics of such instruments, the effect of ageing, the rapidity of response, temperature correction and behaviour at low pressures, these points being illustrated by diagrams. The next point considered is the circuit whereby the double coil resistance is connected to the oscillator circuit and the method of receiving the signals sent out. The possibility of expanding the humidity scale by using different units is outlined and the component parts requisite for a satisfactory unit are stated. Flight tests with such, show marked humidity changes which hair hygrometers show only slightly and that after a considerable time lag. Numerous photographic reproductions illustrate the paper. A. E. M. G.

See also Abstract 3164.

SEISMOLOGY.

3180. Reality of the Seismic-Electric Effect. S. v. Thyssen, J. N. Hummel and O. Rülke. *Beitr. z. angew. Geophys.* 7. 3. *pp.* 209–217, 1938.—Arguments are adduced and experiments described showing a close connection between the seismic-electric effect and electro-chemical polarisation, analogous to the increase in depolarisation caused by agitation of the the electrolyte. C. A. S.

3181. Seismic Electric Effects and their Possible Employment in Seismometry. A. Belluigi. *Beitr. z. angew. Geophys.* 7. 3. *pp.* 260–264, 1938.—The probable origin of the seismic electric effect is discussed, and the explanation of Thyssen, Hummel and Rülke, that it is due to electrochemical variations caused by electric waves, is upheld. The possibility of employing the effect as a basis for the construction of seismometers free from all complications due to inertia is pointed out, and the advantages likely to accrue therefrom emphasised. C. A. S.

3182. Earthquake Problems of India. S. K. Banerji. *Science and Culture,* 3. *pp.* 637–642, *June,* 1938.—A list is given of the reported earthquakes in India for the past 200 years with the probable positions and depths of the foci. A list of all the various waves (refracted, reflected, surface, etc.) follows with a brief account of their nature. Then the question whether a shock begins with dilatation or compression ; the degree of acceleration ; possible tilt of the strata affected ; and effect on buildings, etc., are briefly referred to ; and finally the need for further seismological observation in India is emphasised. C. A. S.

3183. Earthquakes and Seismic Methods in Submarine Geology. N. H. Heck. *Am. Phil. Soc., Proc.* 79. 1 *pp.* 97–108, 1938.—The connection between earthquakes occurring in, or in the vicinity of, the mid-Atlantic ridge is discussed, and the need of further investigation by means of additional seismic stations and of the explosion method stressed, specially suitable stations being named. The necessity of more or less similar investigations elsewhere of sub-oceanic ridges and oceanic deeps is also urged. In this way it is hoped that information of the structure and nature of the ocean floors may be obtained. C. A. S.

3184. Solar Cycle in Microseismic Disturbances. P. Bernard. *Comptes Rendus,* 206. *pp.* 1585–1587, *May* 23, 1938.—From the observations at Parc Saint Maur yearly means of microseismic disturbances were extracted. It was found that the maxima occurred two years after the maxima of solar activity in 1917 and 1927 and curves show the relation of the two quantities. For Eskdalemuir and Strasburg similar curves are obtained. For La Plata the curves are similar but of opposite phase to those for the northern hemisphere. The microseismic disturbances are related to atmospheric disturbances in the vicinity of Europe and in the S. Atlantic whose frequency and intensity have an 11-year cycle and a maximum as solar activity decreases. R. S. R.

See also Abstract 3167.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

3185. Terrestrial Magnetism and Oceanic Structure. J. A. Fleming. *Am. Phil. Soc., Proc.* 79. 1. *pp.* 109–125, 1938.—Diagrams illustrate the residual magnetic field in different parts of the earth's surface. These are considered to be due to irregularities in the earth's crust and secular variations of terrestrial magnetism may have their origin in deep seated earth movements. The foci of magnetic changes are largely in the northern hemisphere while those in the Pacific are of moderate intensity and ill-defined. Examination of samples of the earth's crust can lead to theories regarding past history of the earth's magnetisation. It is suggested that anomalies of gravity and terrestrial magnetism and of deep earthquakes may have a common origin in the current systems in the inner earth. R. S. R.

3186. Terrestrial Magnetism and Chromospheric Eruptions. J. Coulomb and G. Dugast. *Comptes Rendus,* 206. *pp.* 1582–1585, *May* 23, 1938.—The quick fading of short radio-electric waves coincides in general with chromospheric eruptions and small perturbations of terrestrial magnetism. On the La Cour apparatus at Tamanrasset the amplitude on the horizontal component is about 10γ, and an analysis of 316 cases supports the u.v. theory of the ionosphere. The difference in registration at different stations is shown to be due to the fact that for magnetic effects the maximum occurs at the centre of the bright hemisphere and this was confirmed by using 110 cases of eruptions observed at Mt. Wilson. R. S. R.

3187. Terrestrial Magnetic Activity. J. Bartels. *Terr. Mag.* 43. *pp.* 131–134, *June,* 1938. *In German.*—The tables of monthly and annual means for the measures u and u_1 of terrestrial-magnetic activity for the years since 1835 are continued for the years 1935 and 1936 and supplemented by preliminary values, based on observations at Niemegk alone, up to March, 1938. The recent sharp increase in magnetic activity is discussed and compared with the Zürich sunspot-numbers R. The lag of u behind R is again noticeable. 1937 appears to be the most active year magnetically since the years around the high sunspot-maximum 1870, although no individual storm of outstanding intensity occurred. Three successive storms gave the high value $u = 2\cdot74$ to the month Jan., 1938, a value comparable only with such well-known months as Nov., 1882, Aug.,

1917, March, 1920, or May, 1921. The different degree of terrestrial-magnetic quietness reached during the last four sunspot-minima is discussed. The minima of 1901 and 1913 were appreciably quieter than the minima of 1923 and 1933; this magnetic evidence agrees with solar observations in so far as the sun was free of spots on more days around 1901 and 1913 than around 1923 and 1933. [See also Abstract 1152 (1936).]
AUTHOR.

*3188. **Comparison of Coil-Magnetometer and Earth-Inductor. W. M. H. Greaves and W. M. Witchell.** *Terr. Mag.* 43. *pp.* 137–138, *June*, 1938.

*3189. **Temperature-Compensation of the Unifilar by Means of Thermalloy. B. M. Janowsky.** *Terr. Mag.* 43. *pp.* 143–147, *June*, 1938.—The method of temperature-compensation proposed by the author makes it possible to reduce the temperature-coefficient of the magnetometer to zero; further it has advantages over the existing methods—magnetic, optical, and mechanical—because it does not require supplementary arrangements in the magnetometer, thus simplifying in a considerable degree the construction of the magnetometer. The second advantage of the new method is that the compensation does not depend on the value of the magnetic field in which the magnetometer is placed.
AUTHOR.

*3190. **Effect of Torsion in Quartz Horizontal-Intensity Magnetometer Observations. H. H. Howe.** *Terr. Mag.* 43. *pp.* 167–170, *June*, 1938.—Using approximations to the trigonometric functions involved, a simple expression is obtained for the error resulting from imperfect elimination of initial torsion in the fibre. AUTHOR.

3191. **Lunar Diurnal Variation in Earth-Currents at Huancayo and Tucson. W. J. Rooney.** *Terr. Mag.* 43. *pp.* 107–118, *June*, 1938.

See also Abstracts 3168, 3405.

RADIOACTIVITY.

3192. **Artificial Radioactivity. Part III. K. Diebner and E. Grassmann.** *Phys. Zeits.* 39. *pp.* 469–501, *June* 15, 1938.—Continuing previous work [see Abstract 3310 (1937)] review is made of the present state of knowledge on the production of radioactive elements and the properties of their radiations. The subject is discussed according to the nature of the exciting particles, namely (1) α-rays, (2) protons, (3) deuterons, (4) neutrons, (5) electrons, (6) positrons and (7) penetrating radiation.
F. C. C.

3193. **Radioelement of Period 3·5hr. Formed in Uranium Irradiated with Neutrons. I. Curie and P. Savitch.** *Comptes Rendus*, 206. *pp.* 1643–1644, *May* 30, 1938.—Further chemical tests show that this element of period 3·5 hr. ($R_{3\cdot 5h.}$) belongs to the family of Ac and the Ce metals. When a HNO_3 solution of $R_{3\cdot 5h.}$ that has been separated on La as carrier, together with one of actiniferous La is fractionally precipitated as oxalates $R_{3\cdot 5h.}$ accumulates in the head-, Ac in the tail-fractions. $R_{3\cdot 5h.}$ is therefore not an isotope of Ac, and can only be a hitherto unknown trans-uranium element. C. A. S.

3194. Radio-Arsenic. P. Harteck, F. Knauer and W. Schaeffer. *Zeits. f. Physik,* 109. 3–4. *pp.* 153–161, 1938.—1750 Wilson chamber tracks of β-rays emitted by radioactive As which was deposited on an Al foil have been measured. Plotting the energy distribution according to the method of Konopinski and Uhlenbeck shows the spectrum to consist of two components, having upper limits of 1·1 and 3·2 eMV, respectively. A few electron pairs have been observed, and with three exceptions, each pair appears simultaneously with an electron track. This suggests that when a β-particle of the lower group is produced, the residual energy comes out in the form of a light quantum, which may produce a pair by internal conversion. The total energy of five of the pairs agrees with this explanation, but of those pairs which are not accompanied by another electron, two have considerably higher, and one considerably lower energy. R. P.

3195. Radioactive Isotopes of Iron. J. J. Livingood and G. T. Seaborg. *Phys. Rev.* 54. *pp.* 51–55, *July* 1, 1938.—Radioactive Fe^{59} has been produced through the reactions $Fe^{58}(d, p)Fe^{59}$ and $Co^{59}(n, p)Fe^{59}$, the half-life is 47 ± 3 days. The emitted particles are negative electrons, most of which have a range of 0·09 gm./cm². Al, while a small number extend to 0·35 gm./cm². Al. The γ-ray shows a half-thickness of 10 gm./cm². Pb. Radioactive Fe^{53} is formed by the two processes $Fe^{54}(n, 2n)Fe^{53}$ and $Cr^{50}(\alpha, n)Fe^{53}$, positrons are ejected with a half-life of 8·9 ± 0·2 min. No subsequent decay of Mn^{53} to Cr^{53} has been observed. No activity corresponding to Fe^{55} has been detected, although Cr, Mn, Fe, Co and Ni have been bombarded with protons, neutrons, deuterons and α-particles in all the combinations that might be expected to produce this isotope. It is concluded that Fe^{55} is either stable or has a very long or a very short life. AUTHORS.

3196. Neutrons by α-Particle Bombardment of Light Elements. C. S. Copeland and S. C. Lind. *J. Phys. Chem.* 42. *pp.* 567–574, *May,* 1938.—All of the elements from Li through Ca, with the exception of the rare gases, have been investigated for neutron emission under α-particle bombardment. The α-particle source used was radon, and in each case the neutron yield was determined by measurement of the radioactivity induced in iodine. Positive neutron emission was observed for Li, Be, B, N, F, Na, Mg, Al, P and Cl. The neutron emission from C, SiO_2, S, K_2CO_3, $CaCO_3$ and Zn is less than 0·5% of the emission from Be. AUTHORS.

3197. Disintegration of Boron by Slow Neutrons. C. O'Ceallaigh and W. T. Davies. *Roy. Soc., Proc.* 167*A*. *pp.* 81–98, *July* 7, 1938.—The disintegration of B by slow neutrons—${}_5B^{10} + {}_0n^1 \rightarrow {}_3Li^7 + {}_2He^4 + Q_1$—has been studied in an expansion chamber. Evidence has been found for the emission of three groups of heavy particles of ranges 4·25 ± 0·2 mm., 7·15 ± 0·25 and 8·9 ± 0·4 mm. in air at 15° C. and 760 mm. The 4·25 mm. group is clearly due to the Li nucleus. On the basis of the recent range-energy determinations of Blewett and Blewett, the 7·15 and 8·9 mm. groups, which consist of α-particles, would lead, respectively, to energy releases of $2 \cdot 45 \times 10^6$ eV and about 3×10^6 eV. Substitution in the equation of reaction of the values for the masses at present accepted, leads to a value for Q_1 of $2 \cdot 99 \times 10^6$ eV. The 8·9 mm. α-particles would correspond, therefore, to the production of the Li^7 nucleus in the ground state, and the 7·15 mm. particles to an excited nucleus having an energy of $0 \cdot 55 \pm 0 \cdot 15 \times 10^6$ eV above the ground state. Evidence based on the emission of two groups of protons in the reaction

${}_3Li^6 + {}_1D^2 \rightarrow {}_3Li^7 + {}_1H^1$ leads to the prediction of one low-lying excited state of the Li^7 nucleus of $0 \cdot 44 \times 10^6$ eV. This is confirmed by absorption measurements on the γ-radiation accompanying this disintegration. The value $0 \cdot 55 \pm 0 \cdot 15 \times 10^6$ eV is in satisfactory agreement with the above figure. A study of the γ-radiation arising from the non-capture excitation of the Li^7 by α-particles would seem to indicate the presence of two low-lying excitation levels of $0 \cdot 4$ and $0 \cdot 6 \times 10^6$ eV, but it is possible that transitions to the $0 \cdot 6 \times 10^6$ eV level are not allowed in the above reactions.
AUTHORS.

3198. Excitation Function for the Disintegration of Li^7 by Low Energy Protons. L. J. Haworth and L. D. P. King. *Phys. Rev.* 54. *pp.* 38–47, *July* 1, 1938.—Accurate measurements were made of the yields of 8 cm. α-particles from thick and thin films of Li bombarded by homogeneous beams of protons in the energy range from 38 to 210 kV. Careful analyses are described whereby the thin film data were reduced to the values to be expected from films of infinitesimal thickness, thus allowing a relative calculation of the excitation function. From values of the stopping power by other observers the absolute cross-section of the Li nucleus for this process was calculated approximately as a function of the energy. The curves were extended to 400 kV by applying corrections to previously published data of Herb, Parkinson and Kerst [see Abstract 3232 (1935) and following Abstract].
AUTHORS.

3199. Stopping Power of Li for Low Energy Protons. L. J. Haworth and L. D. P. King. *Phys. Rev.* 54. *pp.* 48–50, *July* 1, 1938. The stopping power of Li for protons as a function of energy has been calculated in the energy range 35 to 400 kV from measurements by Herb, Parkinson and Kerst and by the authors [see preceding Abstract] of the yields of 8 cm. α-particles from thick and thin films of Li. The absolute scale of units is based on an extrapolation of values given by Mano for the stopping power at energies above 500 kV. Integration of the reciprocals of the stopping power provides, except for a constant of integration which may be estimated, a knowledge of the range law as a function of energy.
AUTHORS.

3200. Decomposition and Synthesis of HI by α-Particles. K. G. Brattain. *J. Phys. Chem.* 42. *pp.* 617–628, *May,* 1938.—It has been found that the work of Vandamme and of the author, on the decomposition of HI by α-particles, can be explained on the basis that 6 + molecules of HI decompose per HI-ion pair. The experiments of Vandamme and of the author on the synthesis of HI give data for this reaction over a range of I_2 pressure from $0 \cdot 3$ to 350 mm. All the data can be explained on the following basis: (1) for every H-ion pair 6 + molecules of HI are formed; (2) for every seven I-ion pairs 1 molecule of HI is formed; (3) for every HI-ion pair 4 molecules of HI decompose. There is a further indication, from a few of the author's runs at very low I_2 pressure, that either an appreciable back reaction takes place, or not all the H-ion pairs are used up in syntheses.
AUTHOR.

3201. Range and Specific Ionisation of α-Particles. M. G. Holloway and M. S. Livingston. *Phys. Rev.* 54. *pp.* 18–37, *July* 1, 1938.—A study of the specific ionisation of Po α-particles near the end of their range with a shallow ionisation chamber and linear-pulse amplifier has resulted in an accurate determination of the single particle specific ionisation curve and the range energy relation in this region. The method used is to compare the average single particle ionisation in chambers of different depths and from the differences to obtain the ionisation of particles of residual range less than the depth of the chambers. The single particle specific ionisation curve differs from earlier determinations and shows the necessity of a correction to the accepted values of absolute mean range of all α-particle groups. The value suggested for the mean range of Th C′ (at 15° C. and 760 mm.) is $8 \cdot 570 \pm 0 \cdot 007$ cm.; for Po it is $3 \cdot 842 \pm 0 \cdot 006$ cm. It is shown that extrapolated ranges obtained from ionisation measurements differ from those obtained from number distance curves; an empirical relation is suggested to convert such values to mean range. A corrected range energy relation for α-particles extending down to zero range is obtained by combining the results of the present investigations with earlier determinations. AUTHORS.

3202. γ-Ray Ionisation Currents in Air at High Pressures and High Gradients. J. W. Broxon and G. T. Merideth. *Phys. Rev.* 54. *pp.* 1–9, *July* 1, 1938.—With weak sources of γ-rays, ionisation currents in air were measured at pressures between 20 and 200 atm. with collecting fields varied from less than 1 to 4500 V/cm. At all pressures, ionisation currents were found to continue increasing with increase of collecting field intensity throughout the range employed. The ionisation current measured with a particular collecting field intensity does not continue to increase with pressure but has a maximum value in the neighbourhood of 140 atm. Rates of collection of negative ions were found under all conditions to be greater than rates of collection of positive ions under the same conditions. [See following Abstract.]. AUTHORS.

3203. Analysis of High Gradient, High Pressure, γ-Ray, Air Ion Current Measurements, by Zanstra's Adaptation of Jaffé's Columnar Theory. J. W. Broxon and G. T. Merideth. *Phys. Rev.* 54. *pp.* 9–17, *July* 1, 1938.—A brief survey of theories advanced to explain the chief characteristics of high pressure ionisation current measurements is given. The equation developed by Zanstra from Jaffé's theory of recombination of the ions formed by a single particle, yielding a linear relation between the reciprocal of the measured current and a function of the collecting field intensity and pressure, was applied to our high pressure, γ-ray, ionisation current measurements. The curves yielded were not linear, but departure from linearity was rather small in the region of high gradients. By extrapolation, " saturation " current values were obtained. These " saturation " currents were found to vary linearly with the air density over certain pressure ranges, as found by Clay and van Tijn, but changes in slope at very high pressures would indicate a modification of Clay's " wall " radiation theory if the analysis is regarded as reliable. [See preceding Abstract.] AUTHORS.

***3204. Circuits for Control of Geiger-Müller Counters and for Scaling and Recording their Impulses. T. H. Johnson.** *Rev. Sci. Instruments,* 9. *pp.* 218–222, *July,* 1938.—An analysis is given of the controlling action of a valve in circuits similar to those proposed by Neher and Harper and Neher and Pickering [*Phys. Rev.* 53. *p.* 316, *Feb.* 15, 1938]. A modification of the latter's circuit eliminating some of its disadvantages is described. This circuit has been incorporated into a 4-valve network which controls the counter, scales down the impulse rate by any desired factor, and records the scaled counts. A new circuit is also described for recording the impulses from a single counter or from counters connected in coincidence. AUTHOR.

***3205. Thyratron Counter of High Counting Speed and its Development as a Recording Chronograph. F. L. Uffelmann.** *Journ. Sci. Instruments,* 15. *pp.* 222–226, *July,* 1938.—A thyratron "scale-of-two" counting unit was found capable of continuous operation at an input frequency of 20 kc./sec. A complete counter of seven units has been designed to count the periods of a 12 kc./sec. oscillator. By means of a special circuit the counting can be started and stopped at will. This affords an accurate means of measuring time intervals, the maximum error being one period of the oscillator, *i.e.*, 1/12000 sec. AUTHOR.

***3206. Automatic Wilson Cloud Chamber. K. Zuber.** *Helv. Phys. Acta,* 11. 4. *pp.* 366–369, 1938. *In German.*—A new arrangement of the automatic Wilson cloud chamber is provided, an important feature of which is the way in which iron is used to increase the strength of the usual air-core magnet. F. C. C.

See also Abstracts 3044, 3216, 3348.

RADIATION.

ABSORPTION.

3207. U.V. Absorption of Gold and Silver. D. Coster, S. Hof, G. Rathenau and C. F. E. Simons. *Physica,* 5. *pp.* 643–656, *July,* 1938. *In English.*—A vacuum spectrograph with glass grating of 2 m. radius is described. The absorption of metallic gold and silver in the region 2100–1450 Å is determined. The distribution of oscillator-strength connected with $d \rightarrow p$ transition lies for silver farther in the u.v. than for gold, which shows that in the metallic state the *d*-electron for silver is more firmly bound than for gold. AUTHORS.

See also Abstracts 3225, 3228.

COLORIMETRY.

3208. Attributes of Colours and Colour Measurement. W. Ostwald. *Preuss. Akad. Wiss. Berlin, Ber.* 29–30. *pp.* 402–436, 1937.—A presentation of the author's views on the classification and measurement of colour, together with criticism of the trichromatic system. W. S. S.

EMISSION.

3209. Stefan's Radiation Law, Nernst's Heat Theorem and the Pressure of Radiation. E. Guth and A. E. Haas. *Nat. Acad. Sci., Proc.* 24. *pp.* 224–227, *May,* 1938.—The statement sometimes made that the empirical confirmation of Stefan's law represents at the same time an empirical confirmation of Maxwell's formula for radiation pressure is shown to be true only if Nernst's heat theorem (in Planck's formulation) is assumed in addition to the first and second laws of thermodynamics. It is further shown that Stefan's law and Maxwell's formula together with the first and second laws establish Nernst's theorem for the special case of black-body radiation. W. S. S.

3210. Stefan's Law and Non-Linear Electrodynamics. B. Kwal and J. Solomon. *J. de Physique et le Radium,* 9. *pp.* 205–208, *May,* 1938.—Possible forms of Stefan's law at high temperatures and of

Wien's displacement law are discussed on the basis of a non-linear theory of electrodynamics, as in Born's theory. J. S. G. T.

3211. Altitude Effect on the Specific Ionising Power and Zenith Angle Distribution of Cosmic Rays. D. K. Froman and J. C. Stearns. *Canad. J. of Research*, 16. *Sect. A. p.* 105, *May*, 1938.—A correction. [See Abstract 1981 (1938).]

3212. Heavy Electrons in Cosmic-Ray Showers Originating in the Atmosphere. P. Auger, R. Maze and T. Grivet-Meyer. *Comptes Rendus*, 206. *pp.* 1721–1723, *June* 8, 1938.—Coincidence counting was carried out under a light roof using widely-separated large counters. Even with the counters 5 m. apart showers were recorded. Shielding the counters with 10 cm. Pb reduced the rate considerably but did not entirely eliminate the showers. Showers were observed covering an area of at least 20 m^2. and containing about 1000 rays, of which a large proportion are probably heavy electrons. This result favours the hypothesis that the penetrating component of the cosmic radiation is of secondary origin. D. H. F.

3213. Transition Effects of Cosmic Rays in the Atmosphere. H. Snyder. *Phys. Rev.* 53. *pp.* 960–965, *June* 15, 1938.—In this paper is given an improved treatment of the multiplication and absorption of cosmic-ray electrons and γ-rays in the atmosphere. After a brief recapitulation of the principal processes involved in the cascade theory of showers and the resulting diffusion equations, a solution of these diffusion equations is given, making no further approximations. An expression for the probable number of charged particles is given; the values of the functions necessary for numerical calculations are given in a tabular form. It is shown how the Bhabha-Heitler cut-off energy method for estimating the effect of ionisation losses may be consistently used. A comparison is made with the Carlson-Oppenheimer calculations. The differences near the top of the atmosphere are small and in a direction to improve the agreement with observations. At sea level the new calculations give an intensity roughly $\frac{3}{8}$ of the Carlson-Oppenheimer results. AUTHOR.

***3214. Energy Determination of Cosmic Rays by Magnetic Deflection. H. D. Rathgeber.** *Zeits. f. Physik*, 109. 3–4. *pp.* 273–292, 1938.—By means of an arrangement of counters observations of the deflections undergone by cosmic particles in passing through the field of an electromagnet were made. The magnet, which gave an extended and powerful field in air, was of special construction and is described in detail. The results are shown to be in good accord with Wilson chamber results. It is shown that in earlier measurements by other authors of the deflection of particles passing through a magnetic field in Fe the total induction was effective; and that observations of deflections in electric fields lead to the same mean energy values as other methods. D. H. F.

3215. Emission of Short U.V. Radiation during Structure Formation. Part I. Radiation during Typical Coagulations. A. Rabinerson and M. Filippov. *Acta Physicochimica*, 8. 4. *pp.* 419–440, 1938. *In German.*—Based on experiments with the photoelectron counter it is now established that flocculation by electrolytes of $Fe(OH)_3$– V_2O_5– and sodium oleate sols is accompanied by short-wave u.v. radiation. Dilution of the sols and of the coagulator solutions with water, however, does not produce any radiation. No effect is produced by the flocculation of As_2S_3-sols. Statistical investigation of the numerical data enabled conclusions to be drawn as to the reliability of the results. In agreement with the counter experiments, an investigation with yeast as detector indicated that the flocculation of Fe(OH)$_3^-$, V$_2$O$_5^-$ and sodium oleate sols produçed a mitogenetic effect not occasioned by dilution or observed for As$_2$S$_3$-sols. Consideration of both processes led to the conclusion that for the investigation of the radiation phenomena emanating from physico-chemical process biological detectors must be employed.

H. H. Ho.

See also Abstract 3306.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

3216. U.V. Radiation of Crystals under the Action of γ-Rays. E. K. Zavadovskaya. *Phys. Zeits. d. Sowjetunion*, 13. 2. *pp.* 244–246, 1938. *In English.*—U.v. radiations from NaCl, SiO$_2$, CaCO$_3$ under the action of γ-rays were detected by means of a Geiger-Müller photon tube.

J. E.

See also Abstract 3322.

INTERFERENCE, DIFFRACTION AND SCATTERING.

3217. Origin of the Brilliant Colours of Scaleless Beetles. J. P. Mathieu and N. Faraggi. *Rev. d'Optique*, 17. *pp.* 11–27, *Jan.*, 1938.—The brilliant colours of certain beetles have been attributed by Michelson to metallic reflection by highly absorbing pigments, and by Rayleigh and others to reflection with interference from a stratified transparent layer. The characteristics of the two types of reflection are summarised and the results of an experimental study of the light reflected and transmitted by the teguments of several scaleless beetles are reported. The main conclusion is that Rayleigh's explanation gives better agreement with the experimental measurements. W. S. S.

3218. Theory of Caustic Curves. J. Coulomb. *J. de Physique et le Radium*, 9. *pp.* 178–184, *May*, 1938.—Two theories, those of Young (interference) and Airy-Larmor (diffraction) for fringes near plane caustics are available. The case of a circular caustic is treated on the basis of the wave equation and is generalised with the help of coordinates composed of geodesic conics. The fundamental approximation is that discovered by Fock for Bessel functions. N. M. B.

See also Abstract 3334, 3335.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

3219. Action of Various Elements and Compounds on Photographic Plates. Part II. S. Aoyama and T. Fukuroi. *Tôkohu Univ., Sci. Reports*, 11. *pp.* 641–676, *April*, 1938. *In English. Report No.* 443 *of the Research Inst. for Iron, Steel and Other Metals.*—The present investigation has been made in order to clarify whether the action is due to a direct chemical reaction of activated gases on the photographic plate or to a kind of radiation which may be emitted in the association of the activated gases. Judging from the results of the present experiments, it is concluded that the former view is the more plausible. [For Part I see Abstract 4988 (1934).] AUTHORS.

***3220. Simple Form of Tube Sensitometer. D. L. Edwards.** *Norman Lockyer Observat., Bull.* 1. *pp.* 14–15, *April*, 1938.—The author considers two main problems: (1) the relation between various densities in the photographs and the intensities of the corresponding series; (2) the variation of this relation for light of different colours. The sensitometer suggested provides in effect a series of light sources of known relative intensities, which acting on a plate will produce a series of spots of various densities whose measures correlated with the known density ratios will give the first relation required (differing, however, from plate to plate). A figure is given for the second relation, different coloured glass filters are interposed between the source of light and the series of holes, and the series of exposures made (on different parts of the plate) give the changes in the density-intensity relation with changes in colour of the sources. Three figures are given. A. S. D. M.

3221. Graininess of Negative Layers. G. Hansen and P. H. Keck. *Zeits. f. wiss. Phot.* 37. *pp.* 86–97, *April, and pp.* 99–106, *May,* 1938.—Deals principally with previously published work, discussing the limits of the idea, the existing methods and results considering both subjective and objective methods, and the relationship between boundary increase and characteristics of the layer measured objectively. Finally, results obtained by the authors are briefly given and the characterising of the graininess by means of the Callier quotient suggested. R. C. F.

3222. Anomalous Adsorption in Photographic Phenomena. Lüppo-Cramer. *Kolloid Zeits.* 83. *pp.* 322–323, *June,* 1938.—Examines more fully, by dealing with blackening curves, some of the anomalous effects previously discussed [see Abstract 2432 (1938)], and suggests that to neutralise the fogging effect of the sulphite contained in normal developers it is advisable to use iron oxalate. Further, the results obtained from gelatin-free emulsions do not support the theory that the ripening nuclei, which consist in part of Ag_2S when gelatin is present, play a part in these effects. R. C. F.

3223. Nucleus Constancy of the Latent Image. Lüppo-Cramer. *Phot. Indust.* 36. *pp.* 639–642, *June,* 1938.—Deals with the destruction of the nucleus by dyes, and shows that the reduction in density is very little unless the plate is treated with acid bromide solution. This is discussed, considering mainly previously published results. R. C. F.

3224. Manufacture of Motion-Picture Film. A. E. Amor. *Phot. J.* 78. *pp.* 459–472; *Disc.,* 472–473, *July,* 1938.—Describes modern processes in the manufacture of motion-picture films dealing with film support manufacture, emulsion manufacture and coating, slitting, perforating and packing, testing, motion picture negative and positive films, sound recording films, and sub-standard motion-picture films. R. C. F.

***3225. Analysis Filters in Colour Reproduction. H. D. Murray and D. A. Spencer.** *Phot. J.* 78. *pp.* 474–482, *July,* 1938.—Examines the performance of various types of analysis filters from the point of view of results obtainable from them, without employing masking methods and under practical conditions. The processes of analysis, and additive and subtractive synthesis are theoretically considered, the ideal analysis system also being discussed. Calculated reproduction by additive synthesis of six colours, and by means of subtractive processes are then dealt with, the results showing that variations on the existing standard tricolour filters are not likely to produce a marked improvement in the accuracy of the reproduction process, except possibly with a reduction of analysis sensitivity in the extreme red end of the spectrum, and for hue matching. R. C. F.

3226. Theory of Additive Three-Colour Photography. G. B. Harrison and R. G. Horner. *Phot. J.* 78. *pp.* 424–431, *June,* 1938.—Report of the discussion on this paper. [See Abstract 666 (1938).] R. C. F.

3227. Exposure Times in Aerial Photography. C. A. Traenkle. *Zeits. f. Instrumentenk.* 58. *pp.* 241–250, *June,* 1938.—Theoretically examines the factors affecting the exposure times in aerial photography, and derives expressions whereby satisfactory exposure times can be calculated for any time of the year. R. C. F.

***3228. Dark Room Filters for Use with Infra-Red Photographic Layers. M. Plotnikow.** *Phot. Indust.* 36. *pp.* 503–506, *April* 27, 1938.—Examines the effects of combining $FeSO_4$ and $NiSO_4$ solutions with $K_2Cr_2O_7$ solution for use as filters in infra-red plate working, and compares the results obtained with those for the usual $K_2Cr_2O_7$ and $CuSO_4$ combination liquid filters. It is found that the latter combination is the best over the whole range of infra-red plates examined, but that the combination of a thin $NiSO_4$ or $CuSO_4$ liquid filter with $FeSO_4$ and $K_2Cr_2O_7$ liquid filters is satisfactory for plates which have their maximum sensitivity above 8000 Å. R. C. F.

***3229. Photographic Resolving Power in the Construction of Optical Instruments. G. Hansen.** *Phot. Indust.* 36. *pp.* 692–694, *June* 15, *and pp.* 716–720, *June* 22, 1938.—A lecture review of the *rôle* of photographic resolution in the design and construction of optical instruments. C. B. A.

3230. Measurement of Specular Density. F. H. G. Pitt. *Phot. J.* 78. *pp.* 486–489 ; *Disc.,* 489, *July,* 1938.—Describes a method of effecting the separation, by calculation from suitable experiments, of the specularly transmitted beam from the diffuse light obtained when a sample of photographic material is illuminated. Details of the theory underlying the method are given, and a number of results and graphs illustrate the use of the method described. R. C. F.

See also Abstracts 3231, 3408.

PHOTOMETRY.

***3231. Photoelectric Photometer. R. Herz.** *Zeits. f. wiss. Phot.* 37. *pp.* 107–112, *May,* 1938.—Briefly describes a simple photoelectric photometer for photographic-blackening measurements, using a Se cell and having no compensating device. R. C. F.

***3232. Transformation Pantograph for the Reduction of Microphotometer Tracings. H. Hemmendinger.** *Rev. Sci. Instruments,* 9. *pp.* 178–179, *June,* 1938.—An instrument is described for the continuous transformation to a scale of linear or logarithmic intensity of a galvanometer tracing representing the density of a photographic image. The instrument has few moving parts, and has proved capable of executing the reductions quickly and accurately. AUTHOR.

3233. Selected Ordinates for Luminosity Computations. D. L. MacAdam. *Kodak Research Lab., Comm. No.* 661. *J.O.S.A.* 28. *pp.* 163–166, *May,* 1938.—The selected ordinate method for computing the visual reflectance or transmittance of coloured materials requires the preliminary calculation, for every illuminant concerned, of the wavelengths of the selected ordinates. The cases of 30 ordinates and blackbody illuminants are here considered and it is shown that for radiations corresponding to any two temperatures between 2000° and 4000° K. the selected ordinates are similarly distributed along the wave-length axis but are relatively displaced by an amount $\Delta\lambda = 7 \cdot 20 \times 10^4(1/T_1 - 1/T_2) m\mu$. The errors incurred by adopting this result (which is approximate only) are discussed and shown to be very small. The selected ordinates for the I.C.I. $\bar{x}$ and $\bar{z}$ functions do not conform at all closely to any law of the above form. W. S. S.

POLARISATION.

***3234. Double-Plates for the Detection of Elliptically Polarised Light. G. Szivessy and W. Herzog.** *Zeits. f. Instrumentenk.* 58. *pp.* 229–240, *June*, 1938.—A double-plate is defined as a double refracting plane parallel layer made up of two plates of similar material applied edge to edge and cut so that the principal directions of vibration in the two halves are not parallel. The theory of such plates when they are used in conjunction with an analyser for the detection of elliptically polarised light and for determining its azimuth is developed and optimum conditions for these two purposes are laid down. W. S. S.

See also Abstracts 3063, 3272.

REFLECTION, REFRACTION AND DISPERSION.

3235. Correct Projection of Fluted Films. J. de L. Saint-Genies. *Comptes Rendus,* 206. *pp.* 1803–1805, *June* 13, 1938.—It is shown that in normal projection of fluted films, when the aperture of the projection objective is made equal to that of the fluting, considerable loss of intensity actually occurs, since after transmission through the film, the aperture of the incident light beam is expanded to become equal to the sum of the apertures of the fluting and of the radiant surface of the source as seen from the film. A method of overcoming this disadvantage is outlined. C. B. A.

***3236. Optical Paradox. H. W. Lee.** *J.O.S.A.* 28. *p.* 276, *July,* 1938.—Referring to the optical paradox put forward by Herzberger [see Abstract 1167 (1938)] it is pointed out that this is obvious without analysis. If one lens is corrected for two colours which focus at a point where a second lens is placed (the focal length of this lens for the third colour being equal to the common focal length of the first lens for the first two colours) then the rays of the three colours will emerge parallel from the second lens. A. H.

3237. U.V. Refraction-Dispersion of D_2O. M. Bayen. *Comptes Rendus,* 206. *pp.* 1715–1717, *June* 8, 1938.—The refraction-dispersion of 99·92% D_2O at 18°·9 between $\lambda\lambda$ 2230 and 5490 is given by the formula $n^2 = 1 \cdot 74529 + 2 \cdot 636777 \times 10^{-3}/(\lambda^2 - 0 \cdot 02300) + 3 \cdot 9384 \times 10^{-3}/(\lambda^2 - 0 \cdot 0014375)$, λ being measured in μ. The differences between n for D_2O and for H_2O steadily increase from 467 to 854 $\times 10^{-5}$ as λ decreases from 5791 to 2248 Å. C. A. S.

***3238. Negative Dispersion in Electrically Excited He. M. Kruse.** *Zeits. f. Physik,* 109. 5–6. *pp.* 312–331, 1938.—The negative dispersion of a number of transitions from the 2*s* ^{3}S and 2*p* ^{3}P states of the He triplet system is investigated by the usual interferometer method. Readings are made on the 10830 Å line, and for the 3889 Å line a new continuous light source is described. Relative f-values are calculated for several lines, and absolute values are estimated. C. B. A.

See also Abstracts 3063, 3229.

SPECTROSCOPY.

3239. Quantitative Spectrographic Analysis of Al-Mg Alloys. G. Balz. *Zeits. f. Metallkunde,* 30. *pp.* 206–211, *June,* 1938.—The assumption that the analysis of alloys by spectrographic methods is only slightly influenced by other constituents, was found to be incorrect for the determination of Mg in Al alloys. The analysis of Al alloys containing 10% Zn yielded reproducible results which were consistently too high for the Mg content, if comparison were made with Zn free standards. If standards containing Zn were used, the correct Mg content was obtained. Methods for reducing or eliminating the errors of the determinations are given and the use of standards containing the same constituents is recommended. F. J. B.

3240. Quantitative Analysis of Substances in Solution by U.V. Absorption Spectra. P. Gesteau. *Comptes Rendus,* 206. *pp.* 1806–1807, *June* 13, 1938.—An automatic spectrograph is employed in which the photographic plate is moved by a synchronous motor which simultaneously alters the length of the cell containing the material to be estimated. The length of cell required to prevent blackening of the plate is determined. The concentration is then deduced by comparison with a solution of known strength, photographed on the same plate. C. B. A.

3241. Metallic Explosion Spectra. A. Michel-Levy and H. Muraour. *Comptes Rendus,* 206. *pp.* 1566–1568, *May* 23, 1938.—By exploding a mixture of tetranitromethane and toluene in an apparatus previously described, the spectra of the metals in the body of the apparatus (Al, Cu, Pb, Ca, Fe) are produced [see Abstract 766 (1936)]. The spectra are purely thermal, no external electric field is involved and they are of the types: (1) intense continuous spectra, (2) emission lines of the spark spectra, (3) mixed absorption and emission spectra (using a thin film of Al), (4) arc spectra with absorption lines. H. G. C.

3242. Classification of Sn II Spectrum. W. W. McCormick and R. A. Sawyer. *Phys. Rev.* 54. *pp.* 71–75, *July* 1, 1938.—The spectrum of Sn II, as excited in a hollow kathode discharge in He, has been photographed from 800 to 10000 Å. Some 70 new lines have been classified and 28 new levels established. A few changes have been made in the levels and classifications previously made by Green and Loring, Narayan, and Lang. The $5s^2ms$, $-\,mp$, $-\,md$ and $-\,mf$ series have been extended, and the ^{2}F levels have been resolved for the first time. Six members of the $5s^2mg\,^2$G series have been located and used to make a new determination of the ionisation potential of Sn II as 118,017 ± 3 cm^{-1}. The classification has been checked by series relations, Zeeman patterns, and by comparison with the isoelectronic spectra In I and Sb III. Irregularities in the ^{2}S and ^{2}D terms are explained qualitatively by consideration of interactions with perturbing terms from the configuration sp^2. AUTHORS.

3243. Wave-Mechanical Treatment of Line Broadening. A. Jabłoński. *Acta Physica Polonica,* 6. 4. *pp.* 371–391, 1937. *In German.*—A theory of line broadening is developed on the wave-mechanical basis of the Franck-Condon principle. All the N foreign gas atoms in a system together with a single absorbing or emitting atom are considered as forming an (N + 1)-atomic molecule, and a calculation of the intensity distribution in the broadened line, taking account of single and multiple collisions, is proposed, it being assumed that the eigenfunctions belonging to the translational energy of the perturbing atoms disappear at the walls. The result is independent of the size of the vessel provided that this is large. Weisskopf's treatment is criticised. C. B. A.

3244. Intensity Relations in the L.V. Helium Arc. J. J. Heilemann. *Phys. Rev.* 53. *pp.* 977–983, *June* 15, 1938.—The linear amplifier photo-cell unit from a Razek-Mulder spectrophotometer is used with a high speed monochromator to measure the relative intensity of He spectrum lines under various conditions of excitation; the discharge is developed in a copper ball 10·5 cm. in dia. A linear relation is found between arc current and line intensity for a series of voltages between the excitation potential and 100 V, and from this family of curves a family of excitation functions is drawn for a range of currents up to 30 mA. The voltage intensity relation for 8 He lines (4388, 4438, 4471, 4713, 4922, 5016, 5876, 6678) was determined directly. The results check those of Razek up to 50 V and those of Elenbaas over the entire range, although secondary maxima are indicated in the region between the ionisation potential and 45 V. Additional experiments show that the kathode surface plays a part in determining the character of the discharge, and that the rise in Razek's curves was caused by the discharge changing to the self-maintaining form; the hysteresis observed by him is eliminated by the use of a two-grid electron source. AUTHOR.

***3245. Direct Intensity Registration in Spectrophotometry. M. Minnaert and J. Houtgast.** *Zeits. f. Astrophysik,* 15. 5. *pp.* 354–360, 1938. *In English.*—The device described eliminates the point-by-point conversion of a microphotometric trace, *via* a characteristic curve obtained from calibration exposures, into an intensity record. The thermoelectric current from a Moll microphotometer is diverted from its recording galvanometer to an auxiliary galvanometer whose mirror reflects the light from a vertical slit source on to a diaphragm cut out into a shape corresponding to the (I, T) characteristic curve of the emulsion used. For a transmission T at a certain point in the spectrum being measured, the galvanometer is deflected by an amount proportional to T, and the diaphragm transmits a part of the line source proportional to the light intensity I which produced the spectrum at that point. A lens collects the light which passes the diaphragm and focuses it on to a photo-cell connected with the recording galvanometer of the microphotometer, which will then record light intensities directly. A subsidiary device for absorption spectra compensates for variations in the intensity of the continuous background, and a simple method is described for allowing for false light and various other sources of error by altering the shape of the diaphragm. A. Hu.

3246. Nuclear Magnetic Moment of Li^7 by Perturbation Theory. D. R. Inglis. *Phys. Rev.* 53. *pp.* 880–888, *June* 1, 1938.—Assuming the intrinsic magnetic moments of protons and neutrons are not destroyed by the nuclear binding process and adopting the same rather general exchange interaction between all pairs of heavy particles the magnetic moment of Li^7 is calculated by a perturbation theory. The first-order result is that depending on the interaction details the magnetic moment lies between $0 \cdot 26\mu_N$ and $0 \cdot 30\mu_N$ and that the spin part can differ from the proton magnetic moment by not more than $0 \cdot 03\mu_N$. The second-order modification is very small and positive and towards higher orders convergence is rapid. For the result to be in agreement with experiment the value of the proton magnetic moment must be near the upper limit ($3\mu_N$) of the rather wide range suggested experimentally which seems unlikely. The discrepancy may be associated with the inadequacy of the symmetrical interaction apparent in calculating binding energies. J. E. K.

3247. Effective Cross-Section for Collisions of the Second Kind in Excited Hg Vapour and Hyperfine Structure of Hg Resonance Line 2537 Å. O. Buhl. *Zeits. f. Physik*, 109. 3–4. *pp*. 180–203, 1938.—The effective cross-section for collisions of the second kind in Hg vapour is measured by a method due in principle to Schutz but with various improvements in detail and with resonance radiation filtered by a method due to Mrozowski. The experimental arrangement allows the determination of the h.f.s. of 2537 Å by a magnetic method making use of the Zeeman effect separations calculated by Inglis and good agreement is obtained with the h.f.s. as originally determined by Schuler and Keyston. Cross-sections 3000 times greater than the gas-kinetic cross-section are obtained in the case of resonance excitation by the h.f.s. component of shortest wavelength. The sensitivity of the excited Hg atom to the energy transfer occurring in collisions of the second kind falls off rapidly with increasing detuning of the atomic resonators; it is concluded from the nature of this dependence that the interaction between the Hg atoms in the resonance state is exclusively optical. The effect of foreign gases is investigated and cross-sections are obtained of the same order as the optical collision cross-sections measured by Zemansky; they are likewise dependent on the amount of kinetic energy transferred in the collisions. J. E. K.

3248. Quadrupole Moments of $^{83}_{36}$Kr and $^{131}_{54}$Xe and the Mechanical Moment of $^{83}_{36}$Kr. H. Korsching. *Zeits. f. Physik*, 109. 5–6. *pp*. 349–357, 1938.—From investigations of KrI and XeI lines in the near infra-red it is concluded by means of intensity measurements that the mechanical moment of ^{83}Kr is $I = 9/2$. It follows from measurements of the $(4p^5(^2P_{1/2})5s)_1$ and $(5p^5(^2P_{1/2})6s)_1$ terms of ^{83}Kr that its quadrupole moment is $q = +\,0 \cdot 04 \times 10^{-24}$ cm^2. The quadrupole moment of ^{131}Xe is determined as $(q) = \leqq 0 \cdot 03 \times 10^{-24}$ cm^2. The paper concludes with a table of all quadrupole moments hitherto determined together with corresponding nuclear magnetic and mechanical moments. J. E. K.

3249. Energy Levels of the Electron Configuration p^2p'. M. Masiko. *Phys. Math. Soc. Japan, Proc.* 20. *pp*. 399–402, *May*, 1938. *In English*.—In certain cases the method of Slater gives only the sums of the energies of the states and to find the separate values the secular equation for a Hamiltonian must be solved. The mathematical details are worked out and, for the case of OII, good agreement is found between the experimental and calculated values of the terms. A. H.

3250. *g*-Factors of Inert Gas Terms of Configurations Containing *d*-Electrons. K. Lőrinczi. *Zeits. f. Physik*, 109. 3–4. *pp*. 175–179, 1938.—The *g*-factors of the configurations Ne $2p^5$3d, $2p^5$4d; A$3p^5$4d, $3p^5$5d are calculated theoretically and compared with the author's experimental data for the A $3p^5$5d, $3p^5$6d; Kr $4p^5$6d, $4p^5$7d and $4p^5$8d configurations. J. E. K.

3251. Repetition of Vibration Spectrum of Organic Molecules near each Fundamental and Harmonic of the CH group. Yeou Ta. *Comptes Rendus*, 206. *pp*. 1371–1373, *May* 9, 1938.—The fundamental and harmonic bands of $CHCl_3$, $CHBr_3$, and CHI_3 in the region 1 to $2 \cdot 5\mu$ have feeble satellites which become apparent only when greater absorbing thicknesses are employed. The spectra have been recorded on a self-registering grating spectrometer using thicknesses of 0·1, 1, 2, 5, 10, 50, 100, 180, and 280 mm. $CHCl_3$ and $CHBr_3$ were used in the liquid state and CHI_3 was dissolved in CS_2. The $\Delta\nu$ between feeble and intense members of four principal bands are approximately numerically identical with recorded infra-red and Raman frequencies. Preliminary observations on $CHCl_2 \cdot CCl_3$ and $CHCl = CCl_2$ and contemplated extensions are given. W. R. A.

3252. Infra-Red Absorption of Trisubstituted Benzene Derivatives. Symmetry of Benzene. J. Lecomte. *Comptes Rendus*, 206. *pp.* 1568–1570, *May* 23, 1938.—Examination of 70 trisubstituted derivatives of benzene confirm the attribution to it of a six-fold symmetry [see Abstract 2034 (1938)]. H. G. C.

3253. Infra-Red Absorption by $C^{13}O_2{}^{16}$ at $4 \cdot 375\mu$. A. H. Nielsen. *Phys. Rev.* 53. *pp.* 983–985, *June* 15, 1938.—The fundamental vibration-rotation band ν_3 of $C^{13}O_2{}^{16}$ has been found with its centre at a wave-length of $4 \cdot 375\mu$ or $2284 \cdot 5$ cm^{-1}. The individual lines in the band have been fitted by the formula $\nu_3 = 2284 \cdot 5 + 0 \cdot 780\ N - 0 \cdot 0027\ N^2$ where N takes the values $-2, -4, -6, \cdots$, etc. for the P branch and $+1, +3, +5, + \cdots$, etc. for the R branch. On applying the appropriate mass correction to ν_3 and to the anharmonic constant x_{33} given by Adel and Dennison, these constants take values of $2295 \cdot 8$ cm^{-1}. and $-11 \cdot 4$ cm^{-1}., respectively. Together these constants give the position of the centre of the band as $2284 \cdot 4$ cm^{-1}., which is virtually in perfect agreement with observation. AUTHOR.

3254. Flame Spectra of Aliphatic Halides. Part II. W. M. Vaidya. *Indian Acad. Sci., Proc.* 7*A*. *pp.* 321–326, *May*, 1938.—Bands corresponding to IO, occurring in the flame of methyl iodide, have been obtained in the flame of ethyl bromide. The experimental evidence and the vibrational analysis are in favour of BrO being the emitter of these bands. Also a large number of bands in the yellow-range have been shown to be due to Br_2. [For Part I see Abstract 4983 (1937).] AUTHOR.

3255. Structure and Absorption Spectra of Amino-Derivatives of Triphenylmethane. P. Ramart-Lucas. *Comptes Rendus*, 206. *pp.* 1656–1659, *May* 30, 1938.—Examination of the spectra (u.v. and visible) of amino-derivatives of triphenylmethane (fuchsine, crystal violet, malachite green) does not support the view that the colour of these dyes is due to the presence of ionised atoms in the molecule. The ordinary homopolar formulæ are able to account for the properties of these substances. A. J. M.

3256. Absorption Bands of Rb and Cs. Ny Tsi-Zé and Ch'en Shang-Yi. *J. de Physique et le Radium*, 9. *pp.* 169–170, *May*, 1938.—In the presence of He, Ne, A, N_2 and H_2 sharp and diffuse absorption bands of Rb and Cs are observed to the short wave-length of the second member of the principal series. The position and width of the band depends on the gas used. The intensity of the band increases with the concentration of the alkali and of the gas. H. G. C.

3257. Band Spectrum of Tin Oxide. Part II. P. C. Mahanti and A. K. Sen Gupta. *Zeits. f. Physik*, 109. 1–2. *pp.* 39–51, 1938.—Using a spectrograph of high dispersion, the authors studied the rotation structure of the bands (1,0), (0,0) and (0,1) of the A system of SnO, which appear in the radiation from the tin arc. The bands correspond to the transition $^1\Sigma \rightarrow {}^1\Sigma$, the lower $^1\Sigma$ state being the fundamental state of the molecule made up of Sn(^{3}P) and O(^{3}P). The more important molecular constants of these two states are calculated. The structure lines of the band (0,1) are almost all split into three components and a quantitative determination of the Sn isotope effect can be made. [For Part I see Abstract 2288 (1931).] W. S. S.

3258. Rotation Analysis of the $a^3\Pi \rightarrow X^1\Sigma$ CO Band System. L. Gerö. *Zeits. f. Physik,* 109. 3–4. *pp.* 204–209, 1938.—The Cameron bands of CO are excited in emission in a 6000 V 500 mA a.c. discharge between graphite electrodes in a tube 50 cm. long and 1·5 cm. dia. containing Ne at 2·3 mm. pressure, the necessary O_2 being supplied as required by the heating of $KClO_3$ contained in a sidetube. The spectrum is photographed with a 6·5 m. 30000 lines/in. grating with exposures of 4 to 48 hr. The bands (0,0), (0,1), (0,2), (0,3), (1,3), (1,4) and (2,5) of the $a^3\Pi \rightarrow X^1\Sigma$ intercombination system are photographed and their rotation structure is analysed. [See following Abstract.] J. E. K.

3259. Rotation Analysis of the $C^3\Sigma^+ \rightarrow a^3\Pi$ CO Band System. L. Gerö. *Zeits. f. Physik,* 109. 3–4. *pp.* 210–215, 1938.—In the discharge used for excitation of the Cameron bands [see preceding Abstract] the " 3A" bands of CO are emitted with unusually high intensity. The (0,1), (0,2) and (0,3) bands of this 3A system—the $c^3\Sigma^+ \rightarrow a^3\Pi$ system—are analysed. The $c^3\Sigma^+$ $(v = 0)$ term lies 92076·3 cm^{-1}. above the $X^1\Sigma^+$ $(v = 0,\ J = 0)$ ground state and has a rotation constant $B^0 =$ 1·9653 cm^{-1}. The band system lies below a predissociation level at about 11·5 volt. The reason why the P lines of the (9,18) 4th positive band increase in intensity beyond the predissociation point at 9·57 volt is recognised as due to the superposition of the lines of the (0,1) 3A band. [See following Abstract.] J. E. K.

3260. Rotation Analysis of $a'^3\Sigma^+ \rightarrow a^3\Pi$ Bands of CO. L. Gerö. *Zeits. f. Physik,* 109. 3–4. *pp.* 216–222, 1938.—The $a'^3\Sigma^+ \rightarrow a^3\Pi$ bands of CO are prominent in the emission from the discharge used for excitation of the Cameron bands [see preceding Abstract]. A rotation analysis of the two most intense of these bands, (30,1) and (34,0) at 2670 and 2980 Å is carried out. The initial terms lie respectively 83708 and 85933 cm^{-1}. above the $X^1\Sigma$ $(v = 0,\ J = 0)$ ground state and their rotation constants are $B_{30} = 0{\cdot}83$ and $B_{34} = 0{\cdot}75$ cm^{-1}. The mean spin separations of the $^3\Sigma$ terms are: $F_1 - F_2 = 0{\cdot}80$ and 1·05 cm^{-1}. respectively; $F_2 - F_3 =$ $-1{\cdot}08$ and $-1{\cdot}43$ cm^{-1}. respectively. The initial terms are perturbed by the $b^3\Sigma^+$, $v = 0$ and $v = 1$ terms; corresponding perturbations are also found in the 3rd positive bands. J. E. K.

3261. Absorption Spectrum of Fluorene in Various States of Aggregation. B. Twarowska. *Zeits. f. Physik,* 109. 5–6. *pp.* 403–412, 1938.—The absorption spectrum of fluorene as vapour, as crystal, and in *o*-xylol solution is measured at various temperatures. At − 180° C., the bands which are diffuse at ordinary temperatures are resolved into a series of narrow bands, especially in the case of the crystal. These absorption bands, as well as the fluorescence and phosphorescence bands, can be arranged in groups with constant wave-number differences which correspond with the Raman frequencies. The Raman frequencies for molten fluorene and for a solution in CS_2 are recorded. C. B. A.

3262. Influence of Salts on Absorption Spectra of Aqueous Cobalt Chloride Solutions. R. Brdička. *J. Chem. Phys.* 6. *pp.* 404–405, *July*, 1938.—A note on the paper by J. N. Pearce and L. R. Dawson. [See Abstract 1651 (1938).].

3263. Electronic Band Spectra of the Linear Molecules, $HgCl_2$, $HgBr_2$, HgI_2, and $TeCl_2$. M. Wehrli. *Helv. Phys. Acta*, 11. 4. *pp.* 339–356, 1938. *In German.*—The band spectra of the vapours of the mercuric halides in the Schumann region have been investigated with a vacuum grating and the energy levels of deformation vibrations have been separated, thereby enabling an analysis of the vibration structure to be made. The molecules are linear and symmetrical in absorption and afterwards predissociate. Experimental data are in accord with the theory for such molecules. The electron proper function of these molecules changes its symmetry relative to the centre of symmetry, whereas the band spectrum of $TeCl_2$ is due to a forbidden electron transition by which the symmetry of the proper function does not change. The intensity distribution in $TeCl_2$ is different from that in the mercuric halides. Allowed transitions for mercuric halides are forbidden and inverted in $TeCl_2$. W. R. A.

3264. Emission Bands in the $3\,p^1\Pi_{cd} - 1s^1\Sigma$ System of the Hydrogen Molecule. C. R. Jeppesen. *Phys. Rev.* 54. *pp.* 68–71, *July* 1, 1938.—The $3p^1\Pi_{cd} - 1s^1\Sigma$ band system of H_2, heretofore observed only in absorption, has been discovered in emission. Ten bands from the first three vibrational levels of the excited state are analysed and the rotational and vibrational constants are derived. The *d* component levels of the Λ type doubling are found to be strongly perturbed whereas the *c* components appear to be quite regular. The most significant of the constants derived are as follows: $T_e = 113908$ cm^{-1}., $B_e = 30\cdot56$ cm^{-1}. and $\omega_e = 2353$ cm^{-1}. AUTHOR.

3265. Abnormal Rotation of OH Molecules. H. Wakesima. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 374–376, *May*, 1938. *In German.*—The abnormal intensity distribution of the 3064 Å band in the emission spectrum of water vapour [see Abstract 3737 (1934)] suggested that a similar result would be found with alcohol vapour. The spectrum from a Geissler tube of alcohol vapour has been examined. Contrary to expectation the explanation that the abnormality is due to an excited OH radical is untenable. W. R. A.

3266. Triplet-Triplet Perturbations in Band Spectra. I. Kovács *Zeits. f. Physik*, 109. 5–6. *pp.* 387–392, 1938.—The secular determinant of the $^3\Sigma \rightleftharpoons {^3\Pi}$ perturbation which is of the ninth degree, splits up into products of determinants of the fifth, third and second degree. The author shows that a transformation can be found which allows an explicit calculation of the disturbed terms in first approximation. It follows that the sum of the intensities of the two lines must be equal to the intensity of the hypothetical line which would occur without perturbation. Furthermore, the intensities of the two components of the disturbed line are inversely proportional to their displacement from the position of the hypothetical undisturbed line. L. K.

3267. Singlet-Triplet Perturbations in Band Spectra. A. Budó and I. Kovács. *Zeits. f. Physik*, 109. 5–6. *pp.* 393–402, 1938.—The singlet-triplet perturbations occur when two terms intersect. The perturbations can be theoretically calculated by treating the interaction of the spin and orbital impulses of the electrons as perturbation terms in the corresponding Hamilton operator. The authors derive expressions for the transition of the disturbed terms into each other and for the constants B, e and γ of the disturbing term. B, e and γ are calculated for a $^3\Sigma$-perturbation of the A $^1\Pi$-term of CO from the observed doubling of the lines. L. K.

3268. Absorption Spectra of Coordination Compounds. Part I. R. Tsuchida. *Chem. Soc., Japan, Bull.* 13. *pp.* 388–400, *May,* 1938. *In English.*—The origin of the absorption bands of coordination compounds is discussed in detail. The first band is attributed to electron transitions in the unsaturated transition shell of the central ion. The band, therefore, appears only when the central ion is of a transition element. The first band is also more or less additive. The second band is attributed to the coordination electrons and is, therefore, the most general characteristic which a coordination compound should possess. A. H.

3269. Predissociation in the Carbon Monoxide Spectrum at 8·83 Volts. R. Schmid and L. Gerő. *Phys. Zeits.* 39. *pp.* 460–462, *June* 1, 1938.—From the observed predissoication in the Ångstrom bands of CO at 8·83 V it is possible to obtain a more detailed knowledge of the dissociation scheme of CO. [See Abstract 4067 (1937).] W. R. A.

3270. Vibrations of Certain Fluorides. M. Parodi. *Comptes Rendus,* 206. *pp.* 1717–1719, *June* 8, 1938.—Ca F_2, Sr F_2 and Ba F_2 have been examined by the method of residual rays. From their crystalline structure these salts should exhibit two fundamental frequencies of vibration, one active in Raman effect, the other active in the infra-red spectrum. For each, two bands were observed. These are attributed to a fundamental frequency and, the shorter, to a harmonic of the other. Specific heats and Raman frequencies are also discussed. W. R. A.

3271. Transformation of a Band Spectrum into a Continuous Spectrum under the Influence of Pressure. J. Rouvillois and H. Muraour. *Comptes Rendus,* 206. *pp.* 1719–1721, *June* 8, 1938.—The spectra of hexagene (a nitration derivative of hexamethylene tetramine) in air at atmospheric pressure and under pressures of from 20 to 120 kg./cm^2. have been studied. At ordinary pressure bands due to the OH radical are encountered but as the pressure increases these gradually merge to form a continuous spectrum. At 50 kg./cm.^{2} the band spectrum has completely disappeared. Similar observations have been made on other powders and explosives. W. R. A.

3272. Polarisation of the Resonance Radiation of Sodium Vapour. P. Pringsheim. *Physica,* 5. *pp.* 489–494, *June,* 1938. *In German.*—A singlet and a doublet series of the resonance spectrum of Na_2 has been excited by the 4800 and 5086 lines of Cd respectively. The singlet series is 40% polarised and the doublet series 12%. Addition of He to a pressure of 4mm. reduces the degree of polarisation and brings out the D lines unpolarised. The results are shown to be in agreement with theory. J. E.

3273. Resolution and Interpretation of Luminescent Spectra of Solids at Low Temperatures. J. Ewles. *Roy. Soc., Proc.* 167A. *pp.* 34–52, *July* 7, 1938.—Well-defined resolution of the u.v. bands in the kathodo-luminescent spectra of some inorganic solids, activated by various added impurities, has been obtained at the temperature of liquid air. For CaO and SrO constant frequency differences appear which are close to the vibrational frequencies of the crystal lattices. Optically excited luminescent spectra of spectroscopically pure CaO and of CaO activated with Bi show resolved bands in the u.v. which are identical with the kathodo-luminescent bands except for a slight shift towards the red. In general, the bands in the visible are not resolved. In many cases the positions of these bands are determined by the crystal and not by the impurity added. These observations are shown to be in agreement with those of other workers in a number of cases where the partial resolution obtained by them justifies an analysis of their results. It is therefore suggested that the luminescent spectra of certain luminescent solids, notably the alkaline earth oxides and sulphides, may be regarded as electron vibration bands associated with the crystal lattice. In an attempt to interpret the electronic terms of such bands, a certain agreement is shown to exist between the values of these terms and those of electronic transitions of neutral atoms of the metal of the crystal. In this comparison, the striking recurrence of the metastable levels of the neutral atoms suggests a possible mechanism for short duration phosphorescence. AUTHOR.

3274. Zeeman and Paschen-Back Effects in Strong Magnetic Fields. P. Kapitza, P. G. Strelkov and E. Laurman. *Roy. Soc., Proc.* 167A. *pp.* 1–15, *July* 7, 1938.—A method is described for studying the Zeeman and Paschen-Back effects in magnetic fields up to 320,000 gauss. It is shown that the Zeeman splitting is within the limits of experimental error proportional to the magnetic field and obeys the theoretical predictions previously verified only in weaker fields. In strong magnetic fields the authors were unable to discover any displacement of the centre of gravity of the splitting pattern, which again is in agreement with the theoretical prediction. The Paschen-Back effect was studied in fields up to 300,000 gauss on a Be doublet, and it was shown that the splitting accurately followed the theoretical predictions, and that the intensities of the various components agreed qualitatively with the theory. The initial stages of the Paschen-Back effect were also observed for a Zn triplet ^3P–^3S. AUTHORS.

3275. Stark Effect in Multiplet Lines. W. Lochte-Holtgreven. *Zeits. f. Physik*, 109. 5–6. *pp.* 358–373, 1938.—A table of the relative separations of individual multiplet terms is given for doublet to septet spectra. Three summation rules, corresponding to those for the intensities of Zeeman components, are enunciated for the separations in the Stark effect. A table of intensities and polarisations of the components in the Stark effect in multiplet lines is drawn up. The range of validity of the calculations is delimited, and the results are compared with available experimental material. C. B. A.

3276. Raman Spectrum of Indanone. D. Biquard. *Comptes Rendus*, 206. *pp.* 1824–1826, *June* 13, 1938.—The Raman line due to C=O was found to be double in the case of cyclopentanone [see Abstract 3609 (1937)]. For indanone the line is double in the crystalline state but single in the liquid state. **Erratum,** *ibid.* 207. *p.* 352, *Aug.* 1, 1938. H. G. C.

3277. Raman Spectrum of Benzene Under High Dispersion and the Isotope Effect. B. S. R. Rao. *J. Chem. Phys.* 6. *pp.* 343–344, *July*, 1938.—The Raman spectrum of benzene has been photographed using a fine slit and a high dispersion glass Littrow spectrograph. The faint companion at 984 cm^{-1} is found to possess an intensity ratio of 6 : 100 when compared with the principal Raman line at 992 cm^{-1}. The view that this satellite arises from a benzene molecule in which one of the C atoms is replaced by C^{13} is supported by this result. The distribution of intensity in the 3048 and 3062 Raman lines has been determined and the contours of the lines are drawn separately. The peaks of these two lines are found to be in the ratio of 1 : 1·35. The relatively sharp nature of 3062 and the diffuseness of 3048 are correlated with the facts that the former is a well-polarised Raman line whereas the latter is a fully depolarised line. AUTHOR.

3278. Raman Spectra of Compounds Containing the N—S Link. W. R. Angus, A. H. Leckie and T. I. Williams. *Faraday Soc., Trans.* 34. *pp.* 793–797, *July,* 1938.—The Raman spectra of representative members of four different classes of compounds containing the N—S link are recorded. In each spectrum a displacement of approximately 1070 cm^{-1}. is exhibited ; reasons are adduced for assigning this frequency to the N—S link. AUTHORS.

***3279. High-Temperature Vacuum Furnace for Spectroscopic Work. K. R. More.** *Rev. Sci. Instruments,* 9. *pp.* 199–200, *June,* 1938.—A high-temperature vacuum furnace suitable for spectroscopic investigations is described. A coil of tungsten wire is used as the heating element. Thermal insulation is provided by the use of insulating bricks. Temperatures of the order of 2000° C. are attained with a power consumption of 2·5 kW. AUTHOR.

***3280. Spring-Suspended and Thermostated Littrow Spectrograph. N. A. Kent and R. G. Lacount.** *J.O.S.A.* 28. *pp.* 266–268, *July,* 1938.—A system is described for mounting a Littrow spectrograph so as to overcome both mechanical vibration and temperature variation. AUTHORS.

See also Abstracts 3238, 3293.

TRANSMISSION.

3281. Maintaining Transparency in Glass Observation Windows. C. W. Ockelford. *Journ. Sci. Instruments,* 15. *pp.* 190–193, *June,* 1938. —Details are given of a method for maintaining transparency in glass windows employed in connection with the measurement of the absorption of a beam of light passing through a smoke column. The phenomenon of the dust-free space surrounding a body hotter than the ambient air is utilised. W. H. Wal.

See also Abstract 3050.

VISION.

3282. Time of Adaptation after Glare. E. Perucca, C. Brigatti and R. Deaglio. *Accad. Sci. Torino, Atti,* 73. *Disp.* 2*a*. *pp.* 218–227, *Jan.–March,* 1938.—The subject's eye was adapted initially to a brightness B$_0$ which at a given instant was changed to a brightness $B < B_0$. The time to adapt to the brightness B so that an object of fixed contrast could be seen was determined. Measurements were made for various object contrasts and brightnesses B and B$_0$ which were considered of interest in practical problems. W. S. S.

3283. Temperature and the Critical Intensity for Response to Visual Flicker. W. J. Crozier, E. Wolf and G. Zerrahn-Wolf. *Nat. Acad. Sci., Proc.* 24. *pp.* 216–221, *May,* 1938.—The relation between critical flicker frequency and the logarithm of the intensity was determined for the turtle *Pseudemys* at different temperatures. The shape of the curve remains unchanged but there is a shift towards higher intensities as the temperature is lowered. The implications of this result are discussed. [See following Abstract.] W. S. S.

3284. Specific Constants for Visual Excitation. W. J. Crozier, E. Wolf and G. Zerrahn-Wolf. *Nat. Acad. Sci., Proc.* 24. *pp.* 221–224, *May*, 1938.—Determinations of the curve relating critical flicker frequency and logarithm of the intensity were made for albino individuals arising by mutation in a stock of the teleost *Xiphophorus helleri*. The curve is identical with that obtained for normal, pigmented individuals and it is concluded that retinal pigmentation (or iris pigmentation) has no influence on the functioning of the elements sensitive to flicker. [See preceding Abstract.] W. S. S.

***3285. Adaptometer for Measuring Human Dark Adaptation. S. Hecht and S. Shlaer.** *J.O.S.A.* 28. *pp.* 269–275, *July*, 1938.—An instrument is described for measuring the course of human visual dark adaptation under specified but flexible conditions useful for physiological and clinical investigation. The preadapting light adaptation is controlled in brightness, retinal location, and duration, and the subsequent dark adaptation of a specific retinal area is measured with light flashes whose spectral composition and duration are controlled. AUTHORS.

See also Abstract 3208.

X-RAYS.

***3286. Automatic Regulation of Current in Shearer X-Ray Tube. H. le Caine.** *Canad. J. of Research*, 16. *Sect. A. pp.* 100–104, *May*, 1938.—A device for rendering automatic the operation of a Shearer X-ray tube is described. Its functions are : (*i*) to regulate the leak valve mechanically so as to maintain a constant current ; (*ii*) to disconnect the high tension transformer and close the leak valve when a failure of any part of the vacuum system causes high pressure and excessive tube current, the tube restarting as soon as the pressure again becomes low enough. Standard, inexpensive, radio parts, a small motor, and suitable gearing to connect motor and valve are all that are required. The limits within which the tube current can be held may be made very narrow. AUTHOR.

3287. Total Reflection and Dispersion of X-Rays. T. Derenzini. *N. Cimento*, 15. *pp.* 121–132, *Feb.*, 1938.—Experimental investigations and the theory of the total reflection and dispersion of X-rays are reviewed. Ewald's modification of the Bragg relation, introducing the refractive index, is mentioned and the work of Kiessig and Jentsch on the reflection of X-rays discussed in some detail. The agreement between the theories and the experimental data is generally satisfactory. In the neighbourhood of an absorption band the formulæ of Kallmann, Mark and Prins predict the variation of the refractive index with some exactness. C. J. B. C.

3288. Characteristic Temperature of MgO from X-Ray Measurements. H. S. Ribner and E. O. Wollan. *Phys. Rev.* 53. *pp.* 972–976, *June* 15, 1938.—The characteristic temperature for MgO has been directly measured by the X-ray method and a value of $\Theta = 743°$ K. for the range between room-temperature and the temperature of liquid air obtained. A value of Θ was also obtained with the aid of theoretical f_0 values and the result so obtained was found to be in qualitative accord with the above value. In this connection it was noticed that the theoretical f_0 values for MgO are considerably in error. The characteristic temperature determined by the usual method from specific heat data shows a considerable dependence on temperature but the mean of these values over the range under consideration is in good accord with the X-ray value. AUTHORS.

3289. Extension of the X-Ray Spectrum towards the Optical. M. Siegbahn. *N. Cimento,* 15. *pp.* 115–116, *Feb.,* 1938.—An account is given of the experimental methods developed for the examination of long-wave X-ray spectra, with particular reference to the use of a concave lattice. The results are given in the form of Moseley diagrams. It is shown that in the long wave-length region the X-ray spectra are dependent not only on the physical character of the material but to a large extent on its chemical combination. J. T.

***3290. Absolute X-Ray Intensity Measurement. A. Drigo.** *Ricerca Scientifica,* 9. *pp.* 107–115, *Feb.,* 1938.—Describes the construction and performance of a large-sized ionisation-chamber which, used in conjunction with a suitable triode, has been employed for the absolute measurement of X-ray intensity up to 150 kV, with a maximum sensitivity of 10^{-9} *r.* per sec. C. C.

***3291. Sensitivities of X-Ray Counters and Films. A. Drigo.** *Ricerca Scientifica,* 9. *pp.* 301–318, *April,* 1938.—Describes the apparatus and method used and the results obtained in measurements carried out to ascertain the absolute sensitivities of certain types of X-ray films and of certain counters of a modified Geiger-Müller type. The investigations cover the wave-length range of 1–0·1 Å. C. C.

3292. Action of Ionising Radiations on Colloidal Graphite. J. A. Crowther, H. Liebmann and R. Jones. *Phil. Mag.* 26. *pp.* 120–128, *July,* 1938.—Continuous irradiation of colloidal graphite with X-rays produces alternate increases and decreases in the potential of the particles, the maximum change being of the order of 12%. The change of ζ potential for radiation of a given type depends only on the total dose administered, and is independent of the intensity of the radiation. The change is permanent unless the sol is subjected to further irradiation. For a given total dose the change in ζ potential is the same whether the whole dose is given in one exposure or in two partial doses, separated by a time interval of 24 hrs. The phenomenon shows a marked temperature effect, the efficiency of the radiation increasing by 70% if the temperature at which the sol is exposed is raised from 4° C. to 52° C. Significant changes in ζ potential can be produced if the sol is irradiated in the frozen state. Similar effects are caused by γ-radiation. The dose as measured in röntgens necessary to produce a maximum change in the potential of the sol varies with the quality of the radiation employed. There is insufficient evidence to show whether this indicates a real dependence of the phenomenon on the wave-length of radiation. AUTHORS.

See also Abstracts 3054, 3057, 3058, 3071.

HEAT.

CALORIMETRY.

3293. Heat Capacities of Crystals at Low Temperatures. S. C. Sirkar and J. Gupta. *Indian Journ. Phys.* 12. *pp.* 145–154, *April,* 1938.—The heat capacities of crystals of NH_4Cl, CO_2, S and C_6H_6 observed at low temperatures have been examined in order to ascertain whether the observed values of C_p indicate the presence of the contributions of Debye functions corresponding to the new Raman lines in the low-frequency region observed with these crystals. It has been found that in the case of NH_4Cl a Debye function corresponding to the line 183 cm^{-1}., and another Einstein function for the angular oscillations can explain satisfactorily the values of C_p observed at low temperatures. In the case of CO_2 and S on the other hand, Einstein functions corresponding to the new lines, instead of Debye functions, have to be taken into account in order to explain the observed values of C_p. In the case of benzene also, there is agreement between the observed and the calculated values of C_p if the Einstein functions corresponding to the new lines are taken into consideration. It is pointed out that the above fact as well as the selection rules for the appearance of Raman lines due to lattice oscillations, when applied to the crystals of benzene, definitely lead to the conclusion that the new lines are not due to lattice oscillations in the case of benzene. AUTHORS.

3294. Thermal Data of Solid and Liquid SO_2. W. F. Giauque and C. C. Stephenson. *Am. Chem. Soc., J.* 60. *pp.* 1389–1394, *June,* 1938.—The heat capacity of solid and liquid SO_2 has been determined from 15° K. to the boiling point. The melting and boiling points are found to be 197·64 and 263·08° K., respectively. The heats of fusion and vaporisation were measured calorimetrically and found to be 1769·1 and 5960 cal./mole, respectively. The vapour pressure of CO_2 was measured from the melting point to the boiling point. The observations have been represented by the equation: liquid SO_2, 197·64 to 263·5° K. (0° C. = 273·10° K.). $\log_{10}P$ (inter. cm. Hg) $= -1867{\cdot}52/T - 0{\cdot}015865T + 0{\cdot}0000155747T^2 + 12{\cdot}07540$. From the calorimetric measurements, the entropy of SO_2 gas at the boiling point, 263·08° K., was calculated to be 58·07 cal. $\text{deg.}^{-1}\text{mole}^{-1}$. $S^{\circ}_{298.1} = 59{\cdot}23$. This value, which is the most reliable value to use in thermodynamic calculations, agrees with the value calculated by Cross from available molecular data. The agreement is sufficient to show that the entropy of SO_2 approaches zero at the absolute zero of temperature. The experimental entropy value has been used to obtain a more reliable value of the bond angle of SO_2. The angle is calculated to be 129 ± 4°. AUTHORS.

3295. Specific Heats and Heat of Fusion of Iodine. K. J. Frederick and J. H. Hildebrand. *Am. Chem. Soc., J.* 60. *pp.* 1436–1439, *June,* 1938.—Employing the method of mixtures, the heat of fusion of iodine at the melting point was found to be 3740 ± 20 cal./mole. The molal heat capacity of solid iodine in the limited temperature interval 25–113·6° can be expressed within ± 0·5% of the measured values by the equation $c_p = 13{\cdot}07 + 3{\cdot}21 \times 10^{-4}(t - 25)^2$. For liquid iodine from the melting point up to 160°, the molal heat capacity is 19·5 ± 0·3 cal. AUTHORS.

See also Abstracts 3296, 3311.

CONDUCTION.

3296. Distribution of Frictional Heat between Two Bodies. F. Charron. *Comptes Rendus,* 206. *pp.* 1794–1797, *June* 13, 1938.—The distribution of the heat generated by friction between two substances in the form of discs, which are in contact on a common plane surface, and can be rotated relative to each other, is determined experimentally by immersing the discs in two calorimeters. An analogous theoretical treatment to that used by Vernotte [see Abstract 2927 (1938)] when considering the problem of a double wall can be applied to this case. If the surfaces of the discs which are in contact are both assumed to be at the same temperature the flux of heat into each material is found to be proportional to $\sqrt{kc\rho}$, where k, c, and ρ are the thermal conductivity, specific heat and density of the material. The experimental results so far obtained do not obey this law, from which it is concluded that the surface temperatures of two different materials are not equal when rubbed together in this way. R. W. P.

3297. Thermal Conductivity of Gaseous Hydrocarbons and Atomic Polarisation. R. Delaplace. *Comptes Rendus*, 206. *pp.* 1646–1647, *May* 30, 1938.—It has been shown that over a fair range of pressure the thermal conductivities of the saturated hydrocarbons and also those of the ethylenic group arrange themselves in order of increasing atomic weight. The isomers, however, do not fall into line with the series and this note seeks an explanation. By considering the atomic polarisations, derived from the dielectric constants, a similar order is obtained, and it is concluded that this supports the hypothesis that the dynamic structure of the molecule is important in these experiments. E. H. D.

3298. Thermal Conductivities of Hg, Na, and Na-Amalgams in the Liquid State. W. C. Hall. *Phys. Rev.* 53. *pp.* 1004–1009, *June* 15, 1938.—A guard ring method for the measurement of the thermal conductivities of liquid metals in which the furnace automatically attains equilibrium is described. The design of the furnace permits frequent and easy replacement of specimens; a layer of paraffin over the liquid metal prevents oxidation by the air. The thermal conductivities of Hg, of Na and of Na-amalgams ranging in concentration from 70 to 94 atoms % Na are measured over these temperature ranges: Hg, 40° C–220° C.; Na, 85° C.-210° C.; Na-amalgams, 100° C.–150° C. Na behaves as a normal metal, but Hg and the Na-amalgams are abnormal. Some evidence for the existence of the intermetallic compounds Na_5Hg_2 and Na_3Hg in the liquid amalgams at 100° C. is presented by breaks in the thermal conductivity-concentration curve. An eutectic at 86·5 atoms % Na is evident from the same curve. Calculations of Lorentz' number for Na and for Hg are given. AUTHOR.

3299. Thermal Conductivity of Liquids. O. K. Bates, G. Hazzard and G. Palmer. *Indust. & Engin. Chem.* (*Analytical Edition*), 10. *pp.* 314–318, *June* 15, 1938.—The paper presents improvements in the operation of the apparatus previously reported [see Abstract 2780 (1936)], and the results of the determinations of the thermal conductivity and temperature coefficients of thermal conductivity for water-methyl alcohol and water-ethyl alcohol binary mixtures. AUTHORS.

3300. Thermal Conductivity of Solidified Gases and Liquids. A. Eucken and H. Englert. *Zeits. f. ges. Kälte-Ind.* 45. *pp.* 109–118, *June*, 1938.—A method for the determination of thermal conductivity is described which involves an apparatus similar to that of Schleiermacher, but in which observations are made during the variable state, the thermal conductivity being calculated from the rate of temperature rise of the central wire when carrying a steady current. This procedure has the advantage that complications due to the thermal resistance between the heated wire and the material under test are avoided. The performance of the apparatus was checked for liquid glycerin at 0° C. and the method was subsequently used to determine the thermal conductivities of substances at lower temperatures. The following results are considered accurate to ± 2%.

Substance	Temperature °C.	Thermal Conductivity gm.cal./sec.cm. °C.
Benzene (solid)	0	0·000673
	−78·5	0·000749
Glycerin (liquid) ...	0	0·000690
" (glassy solid) ...	−78·5	0·000760
CO_2 (solid)	−78·5	0·00108
	−103·9	0·00128
NH_3 (solid)	−103·9	0·00239

R. W. P.

3301. Conduction of Heat in Crystals. H. B. G. Casimir. *K. Onnes Lab., Leiden, Comm. Suppl. No. 85b. Physica,* 5. *pp.* 495–500, *June,* 1938.—Experiments by de Haas and Biermasz [see Abstract 2071 (1938)] have confirmed Peierls' prediction that at very low temperatures the thermal conductivity of crystals of KCl and quartz depends on the size of the specimen. The problem is now studied by means of a theory in which the scattering of the elastic waves by the boundaries of the crystal is treated as being similar to the diffuse scattering of light by the walls of a tube. The treatment explains the experimental results reasonably well, and indicates that at sufficiently low temperatures the thermal conductivity becomes proportional to the product of the diameter of the rod and the cube of the absolute temperature. R. W. P.

See also Abstracts 3151.

CONVECTION.

3302. Forced Convection with Laminar Flow. G. Ribaud. *J. de Physique et le Radium,* 9. *pp.* 195–204, *May,* 1938.—Following an introductory survey, in which the equations for laminar fluid flow over a plane surface and within a cylindrical tube are given, the author considers the means available for deriving the heat transfer by forced convection in these cases. For the plane surface calculations of the coefficients of convection are made using both Boussinesq's and Pohlhausen's methods for the integration of the heat flow equations, and also the similitude method. Expressions are also derived for the case of a plane in which the heated portion is situated some distance from the leading edge, and for the transfer from the internal walls of a cylinder. R. W. P.

DILATATION.

3303. Thermal Expansion of Liquids. J. Weichherz. *Acta Physicochimica,* 8. 4. *pp.* 503–512, 1938. *In German.*—Assuming that the molecule is the centre of a spherically symmetrical field of force and that the molecular number does not change through association or dissociation, an equation for the thermal expansion of a liquid is developed supposing that the attractive force is given by $F = C/r^2$. The equation is a more general form of the Mendeleef equation. It is shown that there must be for liquids a constant product of the form $(v-v_\infty)(t-t_\infty)$, where v_∞ and t_∞ are the extrapolation values for $t = -\infty$ and $v = \infty$. The validity of the equation is shown for the values of CS_2, C_2H_5OH, $(C_2H_5)_2O$, $n - C_5H_{12}$ and Hg taken from the literature. The values are very constant for each liquid under constant conditions of pressure over large temperature ranges. E. H. D.

◆3304. Thermal Expansion of Crystalline Sodium between 80° K. and 290° K. S. Siegel and S. L. Quimby. *Phys. Rev.* 54. *pp.* 76–78, *July* 1, 1938.—The observed linear thermal expansion of crystalline Na is tabulated at ten-degree intervals between 80° K. and 290° K. The behaviour of this material is in accord with the relation obtained by Gruneisen between thermal expansion and heat content, within the precision measure of the latter quantity. A description of the thermal expansion and cryostatic apparatus is given. AUTHORS.

FUSION AND SOLIDIFICATION.

3305. Freezing Points of Concentrated Aqueous Solutions of Urea, Urethan and Acetamide. H. M. Chadwell and F. W. Politi. *Am. Chem. Soc., J.* 60. *pp.* 1291–1293, *June,* 1938.—This paper reports freezing points of aqueous solutions of urea and urethan over a concentration range to the eutective points, and of acetamide to 3 molal. The temperatures were measured with a Pt thermometer; the concentrations of solutions were determined by a Zeiss water-interferometer. The "preliminary" activity coefficients have been calculated. All of the solutions show positive deviations from Raoult's law. The magnitude of the deviation increases in the order acetamide, urea, urethan. AUTHORS.

TEMPERATURE.

3306. Establishment of Scale of Colour Temperature. H. Djoudat. *Rev. d'Optique,* 16. *pp.* 401–422, *Dec.,* 1937.—Describes the use of a black body held at various temperatures for calibrating tungsten filament lamps of suitable design in terms of colour temperature over the range 1900–2800° K. The temperatures of the black body were measured by means of an optical pyrometer (disappearing filament type) checked at the melting points of Au and Pt. The black body was of the carbon-tube furnace type and it is considered that the values of colour temperature obtained are accurate to 4° C. throughout the range stated. The relat on between colour temperature and current is linear over a wide range (600°) for the lamps used. J. W. T. W.

3307. Temperature of Incandescent Kathodes by Electron Current Measurement. W. Heinze and W. Hass. *Zeits. f. techn. Physik,* 19. 6. *pp.* 166–180, 1938.—It is shown to be possible to measure the temperature of incandescent kathodes of two-electrode tubes by purely electric means, using the current characteristic obtained with retarding potentials, and that the temperatures thus determined are of about the same accuracy as those found by pyrometric methods. It is necessary that the tubes tested should have good insulation, a good degree of vacuum, as well as kathodes with fairly uniform surface properties. In the case of kathodes with non-uniform surfaces an approximate investigation is made of the measurement errors by consideration of the contact potential between various points of the kathode. For three-electrode and multi-electrode valves the accuracy of temperature measurement by the electrical method is in general not sufficient. The reason for this is found to be that in these tubes the irregular potential distribution over the surface of the grid produces a deflecting action on the electrons, which, on account of the finite electrode length, are thereby hindered from reaching the anode. It is therefore concluded that the electric method of kathode temperature measurement is most suitable for diodes and is specially suitable for kathodes coated with some foreign material. A. W.

•3308. Phosphorbronze Resistance Thermometers for Temperatures below 1° K., and Carbon and Ink Thermometers for Use in High Magnetic Fields between 1 and 4° K. H. van Dijk, W. H. Keesom and J. P. Steller. *K. Onnes Lab. Leiden, Comm. No.* 252*g. Physica,* 5. *pp.* 625–629, *July,* 1938. *In English.*—The resistance of a few phosphorbronze thermometers was measured as a function of the Curie temperature of gadolinium sulphate in liquid He down to 0·25° K., and showed a nearly exactly linear dependence on that temperature betwen 1·5 and 0·25° K. Several carbon and ink resistances were measured between 1 and 4° K. in different magnetic fields. Those made from a kind of glass-ink appeared to be the most suitable for measurements in magnetic fields, because they change regularly and considerably with temperature and are very slightly affected even by strong magnetic fields. AUTHORS.

See also Abstract 3294.

THERMOCHEMISTRY.

3309. Heats of Dilution and Heat Contents of Aqueous $CdSO_4$ Solutions. T. H. Dunkelberger and A. L. Robinson. *Am. Chem. Soc., J.* 60. *pp.* 1301–1305, *June,* 1938.—Intermediate heats of dilution of aqueous $CdSO_4$ solutions have been measured over the concentration range from 0·8 to 0·0001 *m* at 10, 15 and 20° and have been extrapolated to infinite dilution to obtain integral heats of dilution. No definite approach to the limiting law of Debye and Hückel is indicated at the lowest concentrations measured. Relative partial molal heat contents and heat capacities have been calculated for the temperature and concentration ranges of the measurements and have been compared with values obtained from e.m.f. measurements by La Mer and Parks. AUTHORS.

3310. Heats of Mixture of Ternary Mixtures. V. Fischer. *Ann. d. Physik,* 32. 4. *pp.* 347–352, *June,* 1938.—General differential equations are derived for the heat of mixture of homogeneous ternary mixtures. The equations do not allow of an unequivocal solution. A possible solution is given for the heat of mixture of EtOH-MeOH-H_2O using experimental data due to Bose for the heat of mixture of the binary mixtures EtOH-MeOH, EtOH-H_2O, and MeOH-H_2O. A. J. M.

3311. Heat of Formation and Specific Heat of Calcium Nitride. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 789. *pp.* 584–595, *June,* 1938. *In English.*—The mean specific heat of calcium nitride was measured by the ice calorimeter over three temperature intervals 0° C. ∼ 99·7° C., 0° C. ∼ 304·3° C., and 0° C. ∼ 500·3° C., and the equation of the true specific heat was obtained over the above temperature intervals : $C. = 0{\cdot}1817 + 1{\cdot}273 \times 10^{-4} t + 1{\cdot}388 \times 10^{-8} t^2$. By using these values, the heat of formation was computed from the dissociation pressure measured at high temperatures. The result obtained is as follows : $3Ca + N_2 = Ca_3N_2 + 108200$. The relationship between the heats of formation of the nitrides of the elements belonging to the second group of the periodic table and their atomic numbers is discussed. [See also Abstracts 2496 and 2943 (1938).]. AUTHOR.

3312. Speed of Propagation of Flames in Air-Propane and Air-Coal-Gas Mixtures. G. Ribaud and H. Gaudry. *Comptes Rendus,* 206. *pp.* 1648–1649, *May* 30, 1938.—The velocity of propagation of flames in gaseous mixtures was investigated in a tube of pyrex glass 9 mm. in dia., the progress being recorded photographically after Mallard and Le Chatelier. Increase of pressure decreases the velocity of propagation. The results obtained with the illuminating gas are not nearly so clear. The flame shows a tendency to oscillate, and over the pressure range 1 to 11 kg. absolute, there is only a 20% variation, the order being 1 m./sec. Over the same range of pressure the variation is of the order of 3 or 4 to 1 with propane. E. H. D.

3313. Explosive Decomposition of Acetylene Accompanied by Flame. A. Gross. *Comptes Rendus*, 206. *pp*. 1654–1656, *May* 30, 1938. —When a current of C_2H_2 is passed through tubes of certain materials no luminous phenomenon is observed, but with others (pyrex, silica, iron, graphite, special steels, etc.) an effect is obtained of which the duration depends on the temperature and the nature of the tube. Two reactions occur : the polymerisation of the C_2H_2, and its decomposition into C and H. The mechanism of the reactions is discussed. A. J. M.

3314. Law of Combustion. H. Muraour and G. Aunis. *Comptes Rendus*, 206. *pp*. 1723–1726, *June* 8, 1938.—The law of combustion by parallel layers has been studied in the case of colloidal powders. From the same powder consisting of cotton powder 66%, nitroglycerin 25%, centralite 8·75%, and vaseline 0·25%, two samples were prepared—one in the form of a long solid rod, and the other a hollow ring-shaped rod. Theory shows that if the law of combustion by parallel layers be correct, the time-pressure curves for the two samples should be identical. The pressures produced during combustion were measured by means of a piezo-electric apparatus and the results plotted in the same curve. The points obtained from the two experiments lie very closely on the same curve, thus showing a remarkable verification of the law in question. G. G.

3315. Two-Stage Auto-Ignition of Hydrocarbons and "Knock." G. P. Kane. *Roy. Soc., Proc.* 167*A*. *pp*. 62–80, *July* 7, 1938.—Previous investigations into the spontaneous ignition under pressure of the higher paraffins and olefins containing more than three C atoms have shown that in the temperature range between *ca*. 270 and 400° C., ignition occurs by a two-stage process preceded by an induction lag t_1 before the formation of a cool flame and a second lag t_2 before the subsequent ignition of the cool-flame products ; increasing pressure shortens both these lags, and although kinetic relationships have been developed it has not been possible adequately to test them hitherto, owing to the extreme violence of the ignitions at pressures much above the minimum ignition pressure. An optical recording manometer is described whereby it has been possible to measure t_1 and t_2 at pressures up to 15 atm. with an accuracy of 1/100 sec. With propane t_2 decreases more rapidly than t_1 with increasing initial pressure, and at a critical pressure (about 8 atm.) the two-stage is replaced by a single-stage process ; the induction lag then decreases very rapidly with pressure. With propylene, where the induction lags are much greater, no such transition had occurred at pressures up to 12 atm. The bearing of these results, both on the nature of the kinetic processes operative and on the problem of " knock," is briefly discussed. AUTHOR.

See also Abstracts 3103, 3241.

THERMODYNAMICS.

3316. Density Differences at the Critical Point according to R. Plank's Equation of State. R. Ruedy. *Canad. J. of Research*, 16. *Sect.A*. *pp*. 89–99, *May*, 1938.—If R. Plank's equation of state [see

Abstract 4282 (1936)] is assumed to apply, the densities measured at two levels, 1 cm. apart, in a column of gas kept at the critical temperature, may differ by more than 5%. A large correction is therefore required for densities determined at the critical point unless the entire contents of the tube is vigorously stirred. Van der Waals' equation shows that the difference in level corresponding to a relative difference in density $(\rho - \rho_e)/\rho_e$, is proportional to the third power of the relative difference ; according to Wohl's equation it is proportional to the fourth, and according to Plank, to the fifth power of the relative difference in density. AUTHOR.

3317. Effect of an Elastic Strain upon Thermostatic Equilibrium. J. E. Verschaffelt. *Physica*, 5. *pp.* 630–634, *July*, 1938. *In French.*—The author disputes the possibility, admitted by Gibbs, of the existence of equilibrium between a fluid phase and an elastically strained solid phase. J. S. G. T.

3318. Theoretical Deduction of Latent Heat of Fusion. N. S. Binayendra. *Gazz. Chim. Ital.* 67. *pp.* 714–715, *Nov.*, 1937.—The parachor represents atomic volume in terms of surface tension, according to the equation $P = M\gamma^{1/4}/(D\text{-}d) = (M/D)\gamma^{1/4}$ approx., if the density of the vapour is small enough to be neglected. (M/D) has the dimensions of a volume, indeed it represents the molecular volume V. Now $L = K(P/V) = K\gamma^{1/4}$, *i.e.*, the latent heat of a metal is a function of its atomic tension. A comparison between observed and values of L calculated in this way, is given :—

Metal	Parachor	Atomic Volume	P/V	Lattice	Constant K	Latent Heat in Kilojoules gm. atom	
						$K\gamma^{1/4}$	observed
Au	61	10·2	5·98	F.C. Cubic	1·9	11·34	13·1
Ag	63	10·3	6·12	„ „	1·9	11·62	11·7
Cu	42	7·1	5·91	„ „	1·9	11·24	11·1
Cd	70	13·6	5·15	Close Packed Hexagonal	1·05	5·40	5·21
Zn	50·7	9·5	5·34	„	1·05	5·60	6·97
Cs	150	70·6	2·12	B.C. Cubic	0·78	1·66	2·09
Rb	130	56·2	2·31	„ „	0·78	1·80	2·18
K	110	45·5	2·42	„ „	0·78	1·89	2·40
Na	80	23·7	3·39	„ „	0·78	2·63	2·63
Li	50	13	3·85	„ „	0·78	3·00	3

On the whole very good agreement is obtained. D. R. H.

3319. Thermodynamic Study of Cd-Sb System. H. Seltz and B. J. DeWitt. *Am. Chem. Soc., J.* 60. *pp.* 1305–1308, *June*, 1938.—The activities and relative partial molal heat contents of Cd and Sb in their liquid alloys have been determined. The abnormal values of these quantities indicate the existence of compounds in the liquid phase. The heat of fusion and the heat and free energy of formation of CdSb have been calculated, and the latter two values shown to be in agreement with those previously determined at lower temperatures with solid electrodes. The heat and free energy of formation of the unstable Cd_3Sb_2 have been calculated. From these data the entropy of this compound at 291·8° K. is found to be 78·9 e.u. AUTHORS.

3320. Heat Capacities, Entropies, and Heats of Solution of Na_2SO_4 and Na_2SO_4, 10 H_2O. Application of the Third Law of Thermodynamics to Hydrated Crystals. K. S. Pitzer and L. V. Coulter. *Am. Chem. Soc., J.* 60. *pp.* 1310–1313, *June*, 1938.—The heat capacities of Na_2SO_4 and Na_2SO_4, 10 H_2O were determined from 14 to 300° K. and their entropies calculated by the usual methods. The heat of solution was measured for each salt. The entropy of the decahydrate was also calculated by use of the known entropy of water vapour and dissociation pressure of the hydrate together with the heats of solution and the entropy of the anhydrous salt. The value thus obtained is 1·7 cal./deg. higher than that calculated from the low temperature heat capacities, thus suggesting the presence of false thermal equilibrium at low temperatures. The cause of this effect is presumably analogous to that in the case of ice, *i.e.*, a randomness in the position of protons forming H-bonds. A value was also obtained for the entropy of SO_4 ion. AUTHORS.

3321. Irreversible Processes at Absolute Zero. C. J. Gorter. *Physica*, 5. *pp.* 483–485, *June*, 1938. *In English.*—It is pointed out that a group of typical low-temperature phenomena, to which Nernst's law applies, appears to be conditioned by a second principle which may be expressed provisionally as the disappearance of irreversible processes at the absolute zero. H. H. Ho.

3322. Nonadiabatic Reactions. Chemiluminescence. M. G. Evans, H. Eyring and J. F. Kincaid. *J. Chem. Phys.* 6. *pp.* 349–358, *July*, 1938.—It is pointed out that chemiluminescent reactions are necessarily nonadiabatic, since emission of radiation can only occur by transition from an upper to a lower potential energy surface. The restriction imposed by the second law of thermodynamics on the photon yield is, $\phi \ll \Delta F/E$, where ϕ is the ratio of quanta evolved to molecules reacted, ΔF is the free energy decrease in the reaction, and E is the energy of the photon emitted. Upper potential energy surfaces are reached either by activation by radiation, which may be that of a black body at the temperature of the reaction, or by the "crossing" of potential energy surfaces. From Audubert's data on the radiation produced by the thermal decomposition of sodium azide approximate surfaces which account for the observations are constructed. AUTHORS.

See also Abstracts 3061, 3102, 3111, 3209, 3288, 3294, 3391.

VAPORISATION AND CONDENSATION.

3323. Boiling Point and Chemical Constitution. Part I. An Additive Function of Molecular Weight and Boiling Point. V. C. E. Burnop. *Chem. Soc., J. pp.* 826–829, *June*, 1938.—The empirical quantity $M \log_{10}T + 8{\cdot}0\sqrt{M}$, denoted by (b), where M is the molecular weight and T the boiling point in degrees absolute, is shown to be additive. By examining the values of (b) for a number of compounds, the contributions to (b) of the separate atoms and structures within the molecule are found. AUTHOR.

3324. Sublimation and Diffusion of Salts and Metals. T. Peczalski. *Comptes Rendus,* 206. *pp.* 1728–1729, *June* 8, 1938.—This paper is a continuation of previous work [see Abstract 1693 (1926)]. Monocrystalline threads of metallic Cu were obtained by heating a Cu tube *in vacuo* for four days at 800°C. By heating $NiCl_2$ for 6 hr. at 850°C. a deposit of metallic Ni was obtained on top of a deposit of Cu from the Cu vessel which contained the salt. Diffusion of the two metals occurs producing the alloy NiCu. The experiments were carried out in a Fe tube which was attacked by free Cl_2 from the dissociated $NiCl_2$. In this way $FeCl_2$ was formed which could be dissolved out from the pores of the alloy. Similar results were obtained using the following salts : KCl, NaCl, $CaCl_2$ and CaF_2. In the case of $MgCl_2$ the reaction takes place with explosive violence. G. G.

ACOUSTICS.

3325. Diffraction by Cylindrical and Cubical Obstacles and by Circular and Square Plates. G. G. Muller, R. Black and T. E. Davis. *Acoustical Soc. of America, J.* 10. *pp.* 6–13, *July,* 1938.—An extension of the work of Sivian and O'Neil [see Abstract 3831 (1932)]. General solutions are obtained for the diffraction of sound waves at the obstacles named, and approximations are derived from these. The sound source was 4′ from the nearest face of the obstacle, and was in the form of an artificial mouth or a h.f. loud speaker. The tests were made in the early morning 10′ above the top of a 50′ tower. The ratio P/P_0 of the pressure at the centre of one surface of the obstacle to the pressure at the same point in space after the obstacle had been removed was determined for various frequencies and angles of incidence, and means were employed to reduce l.f. interference and the effects of harmonics. Groups of curves are given showing the variation of P/P_0 with the ratio of dimension of obstacle to wave-length for cylinder, cube and sphere for angles from 0° to 150°. Other curves show the experimental and computed diffraction caused by cylindrical and cubical obstacles as it varies with the frequency. The curves agree well for angles of incidence not exceeding 90°. For larger angles reflections from the other surfaces play an important part. G. E. A.

3326. Operational Treatment of Nonlinear Dynamical Systems. L. A. Pipes. *Acoustical Soc. of America, J.* 10. *pp.* 29–31, *July,* 1938.—When a mechanical system is undergoing vibrations whose amplitudes are small but not infinitely small, then the Lagrangian equations of motion are of a nonlinear character and the phenomenon is most complex. The Laplacian transform, or operational treatment of linear dynamical systems is being more and more widely employed in the treatment of linear systems leading to a set of ordinary differential equations or to partial differential equations of the linear type. The use of the operational method in nonlinear cases here presented appears to be new. For purposes of illustration, a system of acoustical interest will be considered although the method is general and yields interesting results in a wide variety of cases.

AUTHOR.

3327. Finite Solid Acoustic Filters. R. B. Lindsay and A. B. Focke. *Acoustical Soc. of America, J.* 10. *pp.* 41–44, *July,* 1938.—Calculation is made of the transmission of harmonic compressional waves through a finite solid filter structure consisting of a metal rod loaded at equal intervals with heavy metal collars. The theory is then tested experimentally for the special case where the finite structure (consisting of 6 sections) is terminated by a finite rod with a free end. The structure acts as a low pass filter with a cut-off at about 2000 cycles and no further transmission up to 12,650 cycles. The transmission in the transmission band shows a series of peaks whose positions, with one exception, are accurately verified experimentally. [See also Abstract 2193 (1937).]

AUTHORS.

3328. Vibrations of Symmetrical Plates and Membranes. R. C. Colwell, A. W. Friend and J. K. Stewart. *Acoustical Soc. of America, J.* 10. *p.* 68–73, *July,* 1938.—The mathematical theory of vibrating membranes or plates, which is usually applied to squares and rectangles, may also be used for triangles provided the equations are plotted on axes which are not rectangular. These triangles are then fitted together to produce many side symmetrical plates. Thus the Chladni patterns are found mathematically for polygonal membranes or plates. If one angle of the triangle is made very small, the plates are practically circular so that these equations also give the patterns on circular plates (approximately) for special cases. The triode valve oscillator which drives the plates is calibrated accurately so that the frequency of the plates is found at the time the patterns are formed. A table gives a comparison between the observed and calculated frequencies.

AUTHORS.

3329. Acoustic Spectra of Organ Pipes. C. P. Boner. *Acoustical Soc. of America, J.* 10. *pp.* 32–40, *July,* 1938.—The sounds given by diapason, string and chorus-reed organ pipes made by four different organ makers are analysed up to the 20th harmonic, and their spectra are shown. The different pipes tested were geigen diapason, open diapason, viole d'orchestre and salicional flue pipes, and trumpet and cornopean reed pipes. All were tuned to a frequency 261·6, and their dimensions, shapes and other particulars are tabulated. Flue pipes show a greater variation in intensity than reed pipes when the receiving microphone is moved in a vertical plane from pipe "toe" to pipe top. The difference in patterns for flues and reeds is largely due to the emission from the flue mouth which is not present in reed pipes. In the geigen diapason, the first partial is predominant, whereas in the viole d'orchestre the first four partials are outstanding, and the number and amplitude of upper partials is much greater. The trumpet pipe has ten very strong initial partials. The cornopean (reed pipe with conical horn) has a predominant fundamental and a second partial nearly as strong. The frequency of the flue pipes (261·6) is about 10 higher than the resonant frequency of the pipe. Generally the frequency of a reed pipe is lower than that of either the reed tongue or conical pipe. G. E. A.

3330. Normal Modes of Non-Homogeneous Strings. A. Erdélyi. *Zeits. f. angew. Math. u. Mechanik,* 18. *pp.* 177–185, *June,* 1938.—The normal modes of vibration of a string with a non-homogeneous "parabolic" density-distribution are discussed and approximations for the frequencies are given. The errors in these approximations are also calculated.

G. C. McV.

3331. Velocity of Sound in Oxygen Gas at Liquid Oxygen Temperatures. A. van Itterbeek and O. van Paemel. *Physica,* 5. *pp.* 593–604, *July,* 1938. *In English.*—In continuation of previous investigations [see Abstract 524 (1932)] the authors have studied the velocity of sound in oxygen gas at liquid oxygen temperatures by using ultrasonics. The apparatus is described. The velocity of sound as a function of pressure was determined at seven temperatures and can be represented by $W = W_0(1 + sp)$, where $W_0 = (c_p/c_v)_{p=0}$ (RT/M), $(c_p/c_v)_{p=0}$ being the ratio of the specific heats for an ideal gas; R the gas constant, T the absolute temperature, and M the molecular mass. Further $s = S/RT$, with $S = B + \frac{T}{\lambda}\frac{dB}{dT} + \frac{T^2}{2\lambda(\lambda+1)}\frac{d^2B}{dT^2}$, in which B represents the second virial coefficient, $\lambda = c_v/R$. From these measurements a formula is established for B as a function of T which is valid between 200° K. and 75° K. The values are computed for c_p/c_v, c_v and c_p as a function of pressure at five temperatures within the liquid oxygen temperature region.

AUTHOR.

3332. Velocity and Absorption of Sound in Nitric Oxide in a Magnetic Field. A. van Itterbeek and L. Thys. *Physica,* 5. *pp.* 640–642, *July,* 1938. *In English.*—From previous measurements on the absorption of sound in O_2 it was established that the absorption decreases strongly (about 20%) under the influence of a magnetic field (strength 5 K. Gauss). The authors have now investigated NO in a magnetic field of the same strength. No influence of the magnetic field on the absorption is found. The absorption was determined as a function of pressure. The results obtained are in complete agreement with the theory of classical absorption. The velocity of sound in NO at 16·3° C. was found to be 333·9 m./sec.

AUTHORS.

3333. Supersonics. E. Baumgardt. *Rev. d'Acoustique,* 6. *pp.* 178–209, *Sept.–Dec.,* 1937.—Critical analysis of papers published in 1935–6.

3334. Simultaneous Raman Diffraction with Several Supersonic Waves. L. Bergmann and E. Fues. *Zeits. f. Physik,* 109. 1–2. *pp.* 1–13, 1938.—With simultaneous existence of several supersonic waves a light wave passing through the sound field is diffracted in a way which is complex but which by a small extension of the Raman-Nath calculations can be at once understood. Interferences of mixed order with longitudinal and transversal waves in glass are given in reproductions of the diffraction figures which were obtained. The first portion of the paper is experimental and contributed by L. Bergmann, the second is theoretical by E. Fues and discusses the theories of Raman and Nath. These investigators have explained in a very simple way the processes of diffraction which a light bundle experiences on passing through a travelling or stationary supersonic wave by means of the conception that the phase surfaces of the incident light in consequence of the different optical wave-lengths of its rays are formed like waves on issuing from the supersonic field. [See following Abstract.]

J. J. S.

3335. Dynamical Theory of the Space-Lattice Diffraction. E. Fues. Parts I and II. *Zeits. f. Physik*, 109. 1–2. *pp.* 14–24, *and* 109. 3–4. *pp.* 236–259, 1938.—The dynamical theory of space-lattice diffraction, as it has been developed in various forms by Darwin, Ewald, Lohr, v. Laue and Bethe is deduced as consequential null approximation to the solution of a three dimensional Hill's differential equation. A note calls attention to Försterling's paper [see Abstract 1791 (1934)] which deals with the problem on similar lines. A simple disturbance calculation is developed which (as is usual in the electron theory of metals and in the theory of diffusion of light in sound fields) allows the problem of the diffraction of wave bundles in lattices to be solved. [See preceding Abstract]. J. J. S.

3336. Molecular Rearrangement Induced by Supersonic Waves. C. W. Porter and L. Young. *Am. Chem. Soc., J.* 60. *pp.* 1497–1500, *June*, 1938.—The rates of rearrangement of benzazide in benzene and in aniline under the influence of supersonic waves have been compared with the rate of thermal decomposition at the same temperature. The rate of rearrangement is greatly accelerated by the application of vibrational energy. AUTHORS.

3337. Influence of a Resonator upon a Sound Field. K. Satô and K. Kubo. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 163. *pp.* 239–244, *April*, 1938.—A ray of sound is projected on to a Helmholtz's resonator and the sound field in its neighbourhhood is measured in detail. When the resonator is out of tune, it has but slight effect on the sound field. When the resonator resonates, it accumulates energy from the surrounding field and part of it is re-emitted as a spherical wave. AUTHORS.

3338. Groove-Needle Factors in Sound Reproduction from Gramophone Records. J. A. Pierce and F. V. Hunt. *Acoustical Soc. of America, J.* 10. *pp.* 14–28, *July*, 1938.—A study of geometrical factors affecting the fit of the needle into the groove of the gramophone disc. Tracing distortion [Di Toro] is treated in considerable detail. The stylus must rise and fall twice during the tracing of each fundamental wave-length. An ideal reproducer for lateral cut records must embody sufficient vertical flexibility to enable the stylus to execute this motion faithfully. The lateral motion of a stylus tracing the groove of a lateral cut record is determined by the fundamental and odd harmonics only of the "poid" characterised by the groove amplitude, the wave-length, and the needle radius. The even harmonics of the "poid" appear as vertical motion and constitute the "pinch" effect. Much of the distortion inherent in the reproduction of vertical cut records is entirely absent in the reproduction of lateral cut records when a satisfactory lateral reproducer is used. Methods of reducing distortion due to surface noise are discussed. W. H. G.

3339. Mechanism of the Internal Ear. J. A. Reboul. *J. de Physique et le Radium*, 9. *pp.* 185–194, *May*, 1938.—By using a simplified model of the internal ear similar to that considered by v. Bekesy, the author studies mathematically the propagation of compression waves in the fluid in the *scala vestibuli*, this structure being treated as a conical pipe with elastic walls. The pressures at different distances along this structure are calculated for various frequencies, and it is considered that these pressures cause corresponding movements of the basilar membrane; the latter, it is concluded, vibrates as a reed at frequencies below about 1000 ~, but at higher frequencies has a more complicated vibration pattern. Various well known experimental results are reviewed in the light of this conclusion and it is decided that the assumption of a system of resonators in the basilar membrane is not essential. K. M. C.

3340. Sound Absorption and Dispersion in Liquids. H. O. Kneser. *Ann. d. Physik*, 32. 3. *pp.* 277–289, *June*, 1938.—Absorption and dispersion formulæ of very general form are derived for the propagation of sound in liquids. The formulæ are similar to those which apply to gases and they include two constants showing the dependence of the absorption and velocity on frequency. Absorption measurements for 12 liquids give results in satisfactory agreement with the absorption formula. An explanation is given also as to the reason that up to the present sound dispersion has not been observed in most liquids. Further applications of the formulæ are made to show the dependence of sound absorption of liquids on the temperature and for mixtures on the concentration. A. W.

3341. Acoustical Output of Air Sound Senders. O. Devik and H. Dahl. *Acoustical Soc. of America, J.* 10. *pp.* 50–62, *July*, 1938.—The use of the Rayleigh disc for measurement of extremely great sound intensities is discussed, and it is stated that the Rayleigh disc method is applicable also in this case. The Rayleigh disc may even be used in the open air as part of a pointer instrument when properly shielded, thus giving a means of directly measuring the actual sound intensity (in W/cm^2.) of intense sound fields. The measurement also involves a determination of the direction of propagation of energy. The calculation of the total flux over the opening of a sound sender, giving the actual acoustical output in watts, is in that way very much simplified. As a secondary instrument a crystal microphone, calibrated by comparison with the Rayleigh disc instrument, was used. When used in extreme sound fields it was directly connected with a rectifier galvanometer. Reports are given of measurements of the total output of a membrane sender and of that of a diaphone. In the first case measurements were also made of the different kinds of losses occurring both in the electrical and the acoustical oscillation circuit, while the vibration losses were determined from the power balance and vibration measurements. Oscillograms of sound wave form are given and discussed. AUTHORS.

See also Abstract

2250B Automatic Measurement of Atmospheric Noise in Radio Receivers. K. Maeda and H. Yokoyama.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstracts 3352, 3355, 3418.

CONDUCTION AND DISCHARGE IN GASES.

3342. Nature of Oscillating Spark Discharge. I. Purcaru. *Zeits. f. Physik*, 109. 5–6. *p.* 431, 1938.—Replies to criticisms by Ionescu of the author's work on the oscillating spark discharge [see Abstract 807 (1938)]. W. S. S.

3343. Kathodic Sputtering. U. K. Bose. *Indian Journ. Phys.* 12. *pp.* 95–107, *April*, 1938.—Variation of sputtering with pressure has been investigated quantitatively. It is found that there is a pressure for which the sputtering is a maximum ; below this pressure the sputtering decreases very rapidly, and above it the sputtering changes hyperbolically. Zone formation of the usual type has been investigated. Observations show that the sputtered particles form a pseudo-gas. Some data pertaining to approximate pressure, current, length of dark space, and time of exposure for obtaining films of Cu, Ag, Ni, Fe and Al are given. AUTHOR.

3344. Dynamic Characteristics of Glow Discharge Tubes. H. J. Reich and W. A. Depp. *J. of Applied Physics.*, 9. *pp.* 421–426, *June*, 1938.—This paper describes a method for determining the dynamic current-voltage characteristic curves of glow discharge tubes. The technique differs from that previously used for the oscillographic study of glow tubes in that the manner in which the current varies with time is under control. This is accomplished by the use of a valve to limit the current passed by the glow tube. The rate at which the current rises and falls, the current amplitude, the frequency of repetition of the current cycle, and the interval between cycles can be varied at will by changing the wave form of the voltage applied to the grid of the control tube, and the grid bias of the control tube. A number of oscillograms obtained by this method are shown, and the form of the characteristics is explained on the basis of time taken for ionisation and deionisation of the gas. AUTHORS.

3345. Regularities of Anode Glow in Relation to those of the Layered Positive Column in Hydrogen and Nitrogen. A. Güntherschulze, W. Bär and H. Betz. *Zeits. f. Physik*, 109. 5–6. *pp.* 293–309, 1938.—The anode glow in H, with suitable choice of the experimental conditions, consists of sharply defined and regular figures of great beauty and takes the form of concentric rings or individual spots. Its occurrence is explained by the help of the minimum principle. The size of the spots, as dependent on the current strength and gas pressure, was measured and it was found that the whole surface covered by the anode glow in H was directly proportional to the current strength and inversely to the gas pressure. From the explanation of the patterns obtained it follows that the anode glow should also be observable in N and experiments showed that under suitable conditions this is the case. As a working hypothesis it is assumed that the layers of the positive column and the spots of the anode glow have a common origin, the discrete anode spots being regarded as layers arranged in parallel, the layers of the positive column as anode spots arranged in series. A. W.

3346. Explanation of Action of Hollow Kathodes. A. Lompe. *Zeits. f. Physik*, 109. 5–6. *pp.* 310–311, 1938.—With curved kathodes the effect on the kathode field region of one part of the kathode is influenced by that of the immediately neighbouring parts. It is consequently to be expected that investigation of the current dependence of the kathode fall for kathodes with uniform curvature would be particularly suitable for elucidating the action of the hollow kathode fall observed with cylindrical kathodes. Using a number of spherical kathodes, all having the same surface area but different curvatures, it is to be expected that the kathode fall characteristic will show a dependence on the kathode curvature and that the kathode with the smallest radius of curvature will have the smallest absolute value of the kathode fall and also the smallest slope. Experiments with kathodes of radius from 8·5 to 25 mm. and pressures from 2 to 10 torr.

confirmed this. The curves obtained exhibited no jumps and it thus appears probable that the hollow kathode effect does not set in at some particular radius or gas pressure, but that there is a gradual passage from the high fall values obtained with plane kathodes to the low values obtained with hollow kathodes, the reduction depending on the curvature of the kathode used. A. W.

3347. Effect of Positive Ions on the Mobility of the Electrons in the Hg Arc. W. Elenbaas. *Physica*, 5. *pp.* 568–580, *July*, 1938. *In German.*—Measurements were made of the voltage gradient of the high-pressure Hg arc at fairly low pressures. In this region there are discrepancies between the measured values and the values calculated from measurements in the normal region. These discrepancies can be accounted for by considering the influence of the positive ions on the mobility of the electrons, as calculated by Gvosdover [see Abstract 5420 (1937)]. Other possible explanations of the discrepancies are (*a*) incomplete temperature equilibrium at the relatively low pressures in question and (*b*) the occurrence of extra energy losses. It is considered, however, that the observed discrepancies are to be explained chiefly by the effect of the positive ions. A. W.

***3348. Instability of the Smallest Self-Maintained Gas Discharge; Applications to the Geiger Counter. C. van Geel and J. Kerkum.** *Physica*, 5. *pp.* 609–618, *July*, 1938. *In German.*—In positive corona discharges, as met in Geiger-Müller counters, there is a lower limit below which the current become unstable and is interrupted automatically. An attempt is made to explain this instability from probability considerations. The conditions for counting are examined in pure A and in A mixed with H_2. Deviations from the theory are attributed to the formation of negative ions and their recombination. F. C. C.

***3349. Characteristics of a Strong Ion Source. G. Timoshenko.** *Rev. Sci. Instruments*. 9. *pp.* 187–194, *June*, 1938.—Construction and operating characteristics of an ion source of the capillary arc type are described. The source yields 0·4 mA of singly charged argon ions through an orifice 1 mm. in dia., which allows, with pumping speeds of 14 l./sec., maintenance of a pressure of 5×10^{-5} mm. Hg in the adjacent chamber where the ions are used. The ion beam is easily focused at ion accelerating voltages of 1000 to 6000 V. The source has been used as part of an apparatus for study of controlled sputtering of metals bombarded by argon ions, and the accompanying secondary electron emission. The source can be used advantageously in a number of analogous researches of a fundamental character, and also has application in the field of engineering and biology. AUTHOR.

***3350. Increase of Resolving Power of Mass-Spectrographs. R. Herzog and V. Hauk.** *Phys. Zeits.* 39. *pp.* 463–466, *June* 15, 1938.—It is shown that the resolving power of a mass spectrograph can be increased by replacing the slit of which an image is to be formed by the greatly diminished image of a slit. This can be achieved most suitably by means of a small radial electric field which precedes the ordinary electric field of the mass spectrograph. The thereby altered conditions for double focusing (direction and velocity) are derived and an expression is obtained for the attainable resolving power. In conclusion the advantages and disadvantages of such an arrangement are discussed in detail with reference to a numerical example. J. E. K.

3351. Chemical Actions of Hydrogen Excited by Electrodeless Discharge. H. Nagaoka and T. Mishima. *Imp. Acad. Tokyo, Proc.* 14. *pp.* 128–133, *April,* 1938.—The compounds examined were the fluorides, chlorides, bromides, iodides, oxides, carbonates, nitrates, sulphides and sulphates of most of the elements in the periodic table. The samples were placed near the axis of the discharge tube and spectrograms showing the reductions were obtained. Results are tabulated, and the relation between the heat of formation and the reduction of the compounds is illustrated according to whether or not the elements undergo sputtering in the discharge. N. M. B.

See also Abstracts 3202, 3203, 3204, 3205, 3206, 3290, 3291, 3352.

CONDUCTION IN SOLIDS AND LIQUIDS.

***3352. Measurement of R.F. Voltage in a Cyclotron. W. E. Danforth and M. B. Sampson.** *Rev. Sci. Instruments,* 9. *pp.* 175–178, *June,* 1938.—Three methods of calibrating voltmeters for continuous use with small test electrode during the operation of the cyclotron are described. In the first a pick-up loop is connected through a resistance R and a series condenser with a thermal ammeter. The current I at resonance is simply related to the current in the conductor to the dees to which the loop is coupled. A knowledge of IR, the mutual inductance between these circuits and the capacity of the dee to earth suffices to determine the voltage on the accelerating dees. In the second, an ammeter is connected in series with a resistance between the 'deflector plate' and earth. If the earth susceptance of the deflector plate may be neglected in comparison with the conductance, the voltage on the dees may be derived from the reading of the ammeter and the direct capacitance between the dee and the deflector plate. In the third, a diode rectifier is used. The filament is connected to earth through a high resistance in series with a thermal milliammeter, and through a condenser which is charged to peak voltage by pulses transmitted by the diode. Loss of charge through the resistance is rendered negligible. The product of the resistance and the current which it carries gives the required voltage. T. I. J.

***3353. Potentiometric Measurement of Extremely Small Voltages. I. Amdur and H. Pearlman.** *Rev. Sci. Instruments,* 9. *pp.* 194–195, *June,* 1938.—E.m.f. smaller than 20 μV is measured to an accuracy of 10^{-9} V by application across a shielded Kipp and Zonen original Moll galvanometer, whose deflection is amplified by a photo-cell arrangement. The deflection is balanced out by an auxiliary circuit and the IR drop produced by the balancing current passing through a known resistance is measured potentiometrically. This drop is a simple multiple—given by the ratio of two resistances—of the unknown e.m.f. T. I. J.

***3354. Electrical Control of Galvanometer Characteristics. O. H. Schmitt.** *Journ. Sci. Instruments,* 15. *pp.* 234–236, *July,* 1938.—The usefulness of the ordinary moving coil galvanometer is severely limited by the narrow range of adjustment of period, sensitivity, and damping ordinarily provided. By the use of an appropriate electrical circuit, these factors may be adjusted independently, and through wide ranges plus or minus. Three separate rheostats control respectively: effective stiffness of suspension, effective damping and effective moment of inertia. AUTHOR.

3355. Ratio of International Ohm to Absolute Ohm. R. Jouaust, M. Picard and R. Herou. *Comptes Rendus*, 206. *pp.* 1797–1798, *June* 13, 1938.—The ratio of the international and absolute ohms has been determined by a modification of Campbell's method described by Picard [see Abstract 290 (1930)]. The product of two resistances in absolute units is determined as the product of a self-inductance, a mutual inductance, and the square of a frequency. The two inductances are measured by reference to a standard, the value of which is calculated from its linear dimensions. This standard consists of a helix of 1272 turns wound on a quartz cylinder of length 76 cm. and diameter 9·5 cm. The value obtained for the ratio of the international ohm to the absolute ohm is 1·00052. L. H.

***3356. Simple Bridge for Comparison of Low Resistance Standards. D. C. Gall.** *Journ. Sci. Instruments*, 15. *pp.* 231–232, *July*, 1938. —An instrument for the comparison of four-terminal resistance standards with high precision by a two balance method is described. Two ratios are used. One includes a low resistance slide wire which is calibrated in resistance ratio to 1 part in 10^5. AUTHOR.

3357. Semiconductor in an Alternating Current. G. Dechêne. *Comptes Rendus*, 206. *pp.* 1558–1560, *May* 23, 1938.—The contact capacity between a metal and a semiconductor causes the a.c. to be in advance of the applied p.d. by a phase angle depending on the capacity and resistance of the semiconductor and the contact resistances. The equation obtained is verified by using a kathode-ray oscillograph and it is seen that the capacity can only be found when the resistances of the contacts are sufficiently large and when the frequency of the a.c. is neither too great nor too small. The results for capacity agree with those obtained earlier using d.c. [See Abstract 2137 (1938)]. H. M. B.

3358. System Cu-Cu$_2$O-Cu. E. Wehner. *Phys. Zeits.* 39. *pp.* 445–454, *June* 1, 1938.—Copper oxide was formed on a copper plate and a copper electrode pressed on the oxide layer. Current-voltage, current-applied pressure and current-contact surface characteristics were determined for d.c. and a.c. voltages. The dependence of the current on the contact pressure was smaller with increased pressures over the whole voltage range studied. Two rectifications in opposite directions were found and by suitable variation of voltage and contact pressure a continuous change from one rectification to the other could be produced, a definite reversal point being found. A. W.

3359. Conductivity and Oxygen Excess in Cuprous Oxide. C. Wagner and H. Hammen. *Zeits. f. phys. Chem.* 40. *Abt.B.* 3. *pp.* 197–206, 1938.—The amount of oxygen in Cu$_2$O in excess of that corresponding to the formula is determined at 900° and 1000° C. and at O$_2$ pressures ranging from 0·73 to 33 mm. Hg. Values ranging from 0·30 to 1·14 gm.-atoms of O per gm. mol. of Cu$_2$O are observed. At constant O$_2$ pressure the oxygen excess in the solid phase increases with rise of temperature. The results are discussed in relation to the theory of electrical conductivity of Cu$_2$O previously advanced. [See Abstract 4215 (1933).] L. A. W.

3360. Computation of Ionisation Constants and Limiting Conductance Values from Conductivity Measurements. T. Shedlovsky. *Frank. Inst., J.* 225. *pp.* 739–743, *June*, 1938.—It is found that the range of applicability of the Onsager equation $\Lambda = \Lambda_0 - (\alpha\Lambda_0 + \beta)\sqrt{C}$ is extended up to C = 0·01 by modifying it to $\Lambda = \Lambda_0 - (\Lambda/\Lambda_0)(\alpha\Lambda_0 + \beta)\sqrt{C}$. The use of the modified equation introduces considerable simplification in the treatment of weak electrolytes by the method of Fuoss and Kraus. [See Abstract 2010 (1933).]. L. A. W.

3361. Behaviour of Complex Ions in Strong Electric Fields. H. Diekmann. *Ann. d. Physik,* 32. 4. *pp.* 379–392, *June,* 1938.—The behaviour of complex ions in very strong electric fields has been studied [see Abstract 29 (1935)], and it is shown that there is a considerable splitting effect in addition to the Wien effect. Measurements were made on aqueous solutions of cetylpyridinium chloride and on $MgSO_4$ in glycerol-water mixtures. The presence and extent of both effects was determined at various temperatures and concentrations for different field strengths. The serviceability of the method in elucidating the structure of complex ions is noted. W. R. A.

***3362. Photoelectric Current Limiting Device for Insulation Measurements. E. B. Baker and H. A. Boltz.** *Rev. Sci. Instruments,* 9. *pp.* 196–198, *June,* 1938.—Describes a photo-cell for use as a current limiting device in the measurement of small currents flowing in insulating materials. The cell, which has spherical electrode surfaces of Na, is designed for voltages up to 30 kV, and it is found that the current flowing is sensibly independent of the voltage between 0·1 and 30 kV. The insertion of such a device in series with a sample of insulating material ensures that, in the event of partial or complete breakdown of the sample, practically the whole of the voltage drop is now across the cell, and the current flowing through the sample is thus limited. Under normal conditions the voltage drop across the cell is very small. By varying the light intensity the current passed by the cell is adjustable to any desired value. E. R.

3363. Electrical Volume Resistivity of Insulating Glasses. E. Seddon. *Journ. Sci. Instruments,* 15. *pp.* 226–231, *July,* 1938.—A null method of measuring the electrical resistivity of insulating materials is described, in which the current through the material is balanced against the current required to maintain, at a constant potential, a condenser of which the capacity is being diminished steadily. A Lindemann electrometer is used to indicate the balance. Resistivities from $10^{15}\,\Omega$ downwards of specimens of glass, maintained under controlled vacuum and temperature conditions, can be measured to an accuracy of 5%. AUTHOR.

See also Abstracts 3068, 3069, 3286, 3364, 3365, 3404.

DIELECTRICS AND CAPACITANCE.

3364. Solid Dielectrics in the Alternating Field. F. Borgnis. *Zeits. f. Physik,* 108. 1–2. *pp.* 107–127, 1937.—The experimental investigations of Voglis [see following Abstract] have shown that for certain dielectrics (mica, wax, glass) the secondary current possesses over a large period of time a temporary course of the form $i(t) = B\,(\vartheta + t)^{-n}$ $(0<n<1)$, and the present paper describes the behaviour of such dielectrics in the alternating field under the assumption of the above power series for the after-effect, and the validity of the law of superposition. The incomplete dielectric is described by means of an equivalent electrical picture. The results are compared with previous experimental and theoretical data. H. H. Ho.

3365. Dielectric After-Effects in Solid Non-Conductors. G. M. Voglis. *Zeits. f. Physik*, 109. 1–2. *pp.* 52–79, 1938.—An apparatus was developed which enabled the current carried by a dielectric to be measured in a period from 10^{-2} to 10^{+3} sec. following the application or removal of a d.c. voltage. The charging up and recovery curves were determined for four dielectrics—wax, mica, glass and kerafar U. For mica the effect of voltage change or reversal, and other special points were investigated. The empirical current variation law, $i = A(t/T)^{-n}$, where A, T and n are constants gave a satisfactory first approximation to the curves obtained (except for kerafar U), although deviations were present for long and short times t. Observations on the theory of the effects are included. [See preceding Abstract.]. W. S. S.

3366. Rotation of Molecules in Polar Liquids. S. Oka. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 391–398, *May*, 1938. *In German.*—Mathematical. On the basis of an electrostatic reciprocal effect between dipoles a formula is derived for the Debye rotational coupling energy. W. R. A.

3367. Dielectric Constant of Dipole Liquids. C. J. F. Böttcher. *Physica*, 5. *pp.* 635–639, *July*, 1938. *In English.*—The half empirical formula for the dielectric constant of polar liquids, found by van Arkel and Snoek [see Abstract 1705 (1934)] has been arrived at, starting from Onsager's theory of the reaction field. AUTHOR.

3368. Dielectric Behaviour of the Hydroxides, Oxyhydrates and Oxides of Fe, Be and Mg. O. Glemser. *Zeits. f. Elektrochem.* 44. *pp.* 341–353, *June*, 1938.—A method is developed for the measurement of the dielectric constants of suspensions of solid material in paraffin oil. The method is based upon the bridge method of Nernst. The accuracy was of the order of 0·5%. It was found that hydroxides, hydrates and oxides, *i.e.*, substances which do not contain mobile water, gave the same type of temperature—dielectric constant curve as the condenser. The dielectric constant curves were obtained for $Mg(OH)_2$ and MgO, as well as for $Be(OH)_2$ and BeO, and also for these oxides containing water. F. J. B.

3369. New "Rochelle-Electrics." G. Busch. *Helv. Phys. Acta*, 11. 4. *pp.* 269–298, 1938. *In German.*—Investigation of the dielectric properties of crystals of the salts KH_2PO_4 and KH_2AsO_4 by a.c. bridge methods at low temperatures revealed the existence of "Rochelle-electricity" in the direction of the *c* crystallographic axis. The upper Curie points were 115° and 91° Abs. respectively. The dielectric constants reached maxima of 47500 and 36500 respectively. The polarisation reaches saturation at values 4·3 and 5·0 micro coulombs / cm^2. The *a*-axis is para-electric. The salts $NH_4H_2PO_4$ and $NH_4H_2AsO_4$ are para-electric and suffer transformation at approximately 155° and 220° Abs. P. V.

3370. Dielectric Absorption in Polar Media and the Local Field. R. H. Cole. *J. Chem. Phys.* 6. *pp.* 385–391, *July*, 1938.—The phenomena of dielectric dispersion and absorption in polar liquids subject to applied h.f. electrical fields are discussed on the basis of a modified Onsager theory for the local field. The results of this theory agree quite as well with experiment as do those from Debye's application of the hypothesis of hindered rotation with which the present work is compared. The application of the modified theory to the static case is also considered. A law of corresponding states is found to exist for the alcohols and an empirical equation proposed by van Arkel and Snoek for "normal" polar liquids is shown to have an explanation in terms of the local field. The desirability of more complete measurements of dielectric constants and absorption as a function of temperature and frequency is stressed.

AUTHOR.

***3371. Recent Developments in Electrical Insulating Materials. L. Hartshorn.** *Journ. Sci. Instruments,* 15. *pp.* 217–222, *July,* 1938.—A brief survey of electrical insulating materials which are likely to be of use to physicists is given. The properties of the materials are described with special reference to recent developments which make them suitable for particular applications. The materials considered are divided into the following groups, (1) those used for general experimental work, (2) h.f. work, (3) liquids and fusible materials suitable for impregnation and as immersion media. The substances used for h.f. application comprise synthetic resins and ceramics. A table giving values for electrical and mechanical properties is included. A. M. T.

See also Abstracts 3123, 3297, 3357.

ELECTROCHEMISTRY.

3372. Ag-Ni and Ag-Pt Contacts in Aqueous KI. S. Veil. *Comptes Rendus,* 206. *pp.* 1625–1627, *May* 30, 1938.—With the same notation [see Abstract 1299 (1938)] E_σ for the cell Ag|KI.Aq|Pt is 0·73 V, Pt being the positive pole. (E_s-E_0) $(E_\sigma-E_0)$ *vs.* $\log c/\sigma$ is linear. When other metals replace Ag the resultant e.m.f. is increased by KI as compared with E_0, though to a less extent. The polarity however depends both on the metal and the electrolyte, thus in the cells Ag|$NiSO_4$·Aq or NH_3·Aq|Ni the Ag is positive, in Ag|KI·Aq|Ni it is negative. C. A. S.

3373. Reactions at the Positive Electrode of the Lead Accumulator. V. Sinn. *Comptes Rendus,* 206. *pp.* 1801–1803, *June* 13, 1938.—With the cell PbO_2|H_2SO_4.Aq.|platinised Pt, H_2 the H_2SO_4·Aq being 0·80415N and mechanically stirred, and the H_2 under 25 atm. pressure, the amount of H_2SO_4 consumed in the secondary reaction due to reduction of PbO_2 by H_2 was determined. After allowing for this the results show that the consumption of acid at the positive of the Pb accumulator agrees within $< 1\%$ with that required by the double sulphate theory. C. A. S.

3374. Helmholtz and Nernst. W. D. Bancroft. *J. Phys. Chem.* 42. *pp.* 687–691, *May,* 1938.—This paper reviews the work of Helmholtz and Nernst on concentration cells. The general conclusions arrived at are as follows: (1) the Helmholtz equations for concentration cells coincide with the corresponding equations deduced by Nernst only at infinite dilution. (2) Since the Helmholtz equations are sound thermodynamically, it follows that the Nernst equations are accurate only at infinite dilution. It is not surprising, therefore, that even moderate concentrations cannot be employed. (3) Since the Helmholtz equations involve the change of the vapour pressure with the concentration, the e.m.f. depends also on the concentrations of the undissociated salt, base, or acid. (4) Dolezalek's rather crude application of the Helmholtz theory to the lead storage cell gives fairly good results for the change of e.m.f. with change of H_2SO_4 concentration. If the work were done well, the agreement would undoubtedly be excellent. (5) For reversed zinc-calomel concentration cells Helmholtz was able to get results to within 1 mV, even with a solution containing more than 1 gm. of $ZnCl_2$ per gm. of water. (6) It should be possible to calculate accurately the e.m.f.'s of H_2-H_2SO_4 cells with diffusion up to concentrations at which H_2 reduces H_2SO_4 in a reasonable period of time. (7) Apparently no determination of pH in biological systems can be considered even approximately accurate though the magnitude of the error is as yet unknown. (8) The problem of e.m.f.'s in systems involving complex results is as yet insoluble. H. H. Ho.

3375. Decomposition Voltage of Fused Magnesium Chloride. K. Sano. *Tôhoku Univ., Sci. Reports,* 11. *pp.* 604–610, *April,* 1938. *In English. Report No.* 439 *of the Research Inst. for Iron, Steel and Other Metals.*—From the equilibrium constant of the reaction $MgCl_2 + H_2O = MgO + 2HCl$, the change of free energy for the decomposition of fused $MgCl_2$ is obtained as follows :—$MgCl_2(L) = Mg(L) + Cl_2$. $\Delta F^\circ = 156{,}322 + 13{\cdot}197 T \ln T - 0{\cdot}0005\,T^2 - 124{\cdot}71T$. The decomposition voltages of fused $MgCl_2$ calculated at 700° and 800° are 2·66 and 2·61 V respectively. AUTHOR.

3376. Transference Numbers of Potassium Acetate in Aqueous Solution. D. J. le Roy and A. R. Gordon. *J. Chem. Phys.* 6. *pp.* 398–402, *July,* 1938.—The transference numbers for aqueous solutions of potassium acetate at 25° C. have been determined by the moving boundary method for the concentration range 0·01*N* to 0·25*N*. Two different types of cell and two different methods of measuring the number of coulombs were employed. Up to 0·16 *N* the transference numbers can be represented by the Shedlovsky-Longsworth equation within ± 0·05%, and lead to a transference number for the kation at infinite dilution of 0·6428, in close agreement with that obtained from the limiting ionic mobilities. AUTHORS.

3377. Normal Potential of Cadmium and Radius of the Cadmium Ion in Solutions of the Benzenesulphonate. M. Quintin. *Comptes Rendus,* 206. *pp.* 1564–1566, *May* 23, 1938.—When allowance is made for the hydrolysis of the benzenesulphonate on dilution the theory of Debye as generalised by Gronwall is applicable and gives for the normal potential of the Cd amalgam 0·3436 V, or for Cd itself 0·3941. The radius of the ion Cd^{++} in the benzenesulphonate is 6·2 Å, as compared with 5·4 in $CdCl_2$. [See Abstracts 2144 and 2583 (1938).] C. A. S.

3378. Variation of Polarisation of a Nickel Anode with Time in the Electrolysis of Water in Alkaline Solutions. G. Grube and A. Vogt. *Zeits. f. Elektrochem.* 44. *pp.* 353–360, *June,* 1938.—A pronounced rise in the terminal voltage between a Ni anode and an iron kathode used for the electrolysis of water in alkaline solution was found to take place in the course of days. The cause of the rise was chiefly the increase of the polarisation of the O_2 evolution at the Ni anode. The polarisation was accompanied by the formation of a brown layer of high nickel oxides, which caused a rise of some tenths of a volt of the anode potential in the course of time. The self discharge of this brown layer took place between 0·6 to 0·35 V. The brown layer consists of a solid solution of NiO_2 in Ni_2O_3. F. J. B.

3379. Adsorption at the Mercury Drop Electrode and the Polarographic Current-Voltage Curves. A. Winkel and H. Siebert. *Zeits. f. Elektrochem.* 44. *pp.* 402–410, *July,* 1938.—The current-voltage curves and the electrocapillary curves were determined for the Hg drop

electrode in the presence of reducible substances such as nitrobenzene, dinitrobenzene, o-nitrophenol. The results showed that the reduction of nitro-compounds led to a maximum of the current-voltage curve which was closely governed by the pH value of the solution. The conclusion of the reduction change was indicated by the change of the electrocapillary curve. Adsorption forces persisted after the current maximum had been exceeded. The existing theories do not offer a satisfactory explanation of the existence of the polarographic maxima. The possibility of a concentration of the reduction products in the boundary layer was considered possible.
F. J. B.

3380. Interpretation of Activity Measurements. C. W. Davies. *Faraday Soc., Trans.* **34.** *pp.* 804–805, *July*, **1938.**—The activity measurements recently published by Stonehill [see Abstract 2150 (1938)] are discussed. The arguments advanced for regarding them as incompatible with the incomplete dissociation hypothesis are shown to be invalid.
AUTHOR.

3381. Kathode-Ray Oscillographic Study of Anodic Passivation of Gold in Chloride Solutions. J. D. Pearson and J. A. V. Butler. *Faraday Soc., Trans.* **34.** *pp.* 806–812, *July*, 1938.—The passivation times of gold electrodes in HCl solutions at high-current densities have been examined with a kathode-ray oscillograph. The relation $(i-i_0)t = K$ still holds with the greatest currents that could be passed, but with the larger currents the term i_0t is small and effectively the condition $it = K$ is reached, where K is proportional to the concentration of chloride ions. The interpretation of these observations is discussed, and it is suggested that diffusion can occur at a rate sufficient to replace the ions used up in the electrolytic process at the electrode, until the diffusion layer reaches the constant limiting thickness of about 4×10^{-4} cm. [See also Abstract 471 (1935).]
AUTHORS.

See also Abstract 3104.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

3382. Application of Transverse Field Methods to Measurement of Ionisation and Discharge Cross-Sections. E. Persico and A. Rostagni. *Ann. d. Physik*, **32. 3.** *pp.* 245–252, *June*, **1938.**—The difficulties associated with transverse field methods are mentioned and the interpretation of the results obtained in a number of typical experimental arrangements are discussed.
H. J. H. S.

3383. Energy Loss of Positive Electrons in Passing through Al. B. R. Curtis. *Phys. Rev.* 53. *pp.* 986–991, *June* 15, 1938.—The energy loss of positive electrons between the energies of 0·3 and 1·5 eMV has been determined in a H_2-filled cloud chamber for three thicknesses of Al. The positive electrons, which were obtained by bombarding Fe with deuterons, were passed through Al absorbers of 0·0275, 0·053, and 0·114 cm. thickness, and the values of the average energy loss were compared with the values predicted by the theoretical formula of Bloch. The value of the average energy loss for the 0·0275 cm. thickness was 0·123 eMV, which is roughly 20% greater than the theoretical value; whereas for the 0·053 cm. thickness, the loss was 0·274 eMV, an increase in difference to 40%. A direct comparison of the energy lost by the negative electron with that lost by the positive electron was made using electrons obtained from radio-active P. The results show that there is no essential difference in the amount of energy lost by the two particles.
AUTHOR.

3384. Calculations on a New Neutron-Proton Interaction Potential. R. G. Sachs and M. Goeppert-Mayer. *Phys. Rev.* 53. *pp.* 991–993, *June* 15, 1938.—On the basis of a neutron-proton interaction potential of the form $Ce^{-r/a}/r$ numerical calculations for the deuteron and for the scattering of neutrons by protons have been made. AUTHORS.

3385. Scattering of Fast Electrons in Gases. J. B. H. Kuper. *Phys. Rev.* 53. *pp.* 993–997, *June* 15, 1938.—The angular distribution of elastically scattered electrons of energies between 49·5 and 87·7 ekV has been measured in A, Ne, and He over the range 0·3° to 6°. Comparison of the results with the theoretical curves calculated from the Hartree functions with the "Born approximation" shows good agreement in the case of A, and in Ne except at the smallest angles, but there is no agreement at all in the case of He. The discrepancies are very similar to those found at the smallest angles in studies of scattering of electrons of a few hundred volts energy, and it is felt that the explanation in terms of polarisation of the atomic field by the passing electron may be accepted here also. AUTHOR.

3386. Single Scattering of Fast Electrons in Argon. K. Zuber. *Helv. Phys. Acta,* 11. 4. *pp.* 370–372, 1938. *In German.*—Examination of 350 m. of β-ray track of electrons with energies between 1·7 and 2·4 eMV showed that the single scattering in A was in good agreement with that to be expected on Mott's theory. F. C. C.

3387. Calculation of Elastic Scattering of Electrons by Molecular Hydrogen. R. Roscoe. *Phil. Mag.* 26. *pp.* 32–41, *July,* 1938.—It is shown that the simple Born theory applied to the problem of the elastic scattering of electrons by H_2 gives an expression for the elastic cross-section which approximately equals $8\ \{(8Z^2 + K^2)^2/a_0^4(4Z^2+K^2)^4\}$ $(1+\sin Kd/Kd)$, where Za_0e is the effective nuclear charge occurring in the wave function of the ground state of the molecule. Calculations of the elastic cross-section are made using the four different types of wave function due to Wang, Rosen, and Weinbaum. It is found that the introduction of Weinbaum's "ionic" term into the simple wave function due to Wang decreases the small angle scattering, while Rosen's "polar" term increases it considerably. The function which contains both ionic and polar terms (also due to Weinbaum) gives scattering very close to that obtained from the simple Wang function. AUTHOR.

3388. Interaction between an Electron Beam and a Plasma. M. J. Druyvesteyn. *Physica,* 5. *pp.* 561–567, *July,* 1938. *In English.*—The retardation, scattering and relaxation length of an electron beam through a plasma are calculated and also the scattering of the energy of such a beam. Since the reciprocal effect corresponds to Coulomb's law, an upper limit must be fixed for the distance to the bound electron, in which case a reciprocal effect with the plasma electrons and ions occurs. The formulæ obtained can be used for calculating the energy distribution of electrons in a gas in an electric field with different current densities. For a low current density the distribution is governed by the collisions against the gas molecules; at a higher density encounters take place between the electrons and at very high density the distribution is Maxwellian. The formulæ cannot be used to explain Langmuir's experimental results with beams in a plasma, as the beam intensity was in most cases probably too high. With 10^{12} electrons per cm^3. and a mean energy of the plasma electrons equal to 1 V, the Debye radius is found to be

6×10^{-4} cm. and the relaxation length 10 cm. If 50 V electrons are shot in this plasma, the Debye length is found to be 10^{-2} cm. and the retarding field 0·12 V/cm. A. W.

3389. Probability of Annihilation of Positrons without Emission of Radiation. H. S. W. Massey and E. H. S. Burhop. *Roy. Soc., Proc.* 167*A*. *pp.* 53–61, *July* 7, 1938.—When mutual annihilation occurs on collision of an atomic electron and a positron the energy liberated, instead of appearing as radiation, may be absorbed by a second atomic electron, resulting in its ejection from the atom. In this paper the probability cross-section for this radiationless annihilation process involving the *K*-electrons of a Pb atom is calculated with accuracy, account being taken of the repulsive influence of the nucleus, retardation, spin-spin interaction and electron exchange. Estimates are also made of the contributions from other pairs of electrons and the conclusion is finally reached that the total cross-section for radiationless annihilation by Pb electrons attains a maximum value of between 1 and $1·5 \times 10^{-26}$ cm. for positrons with energy 300,000 eV. The possibility of observing the phenomenon is briefly discussed. AUTHORS.

***3390. Electron Telescope. S. Malatesta.** *Elettrotecnica*, 25. *pp.* 188–190, *March* 25, 1938.—A radiational image in infra-red light is formed on a plane photo-kathode and the electrons emitted are then focused by magnetic or electrostatic fields to form an electron image on a fluorescent screen. In this way an image in visible light is produced of an object or scene emitting only infra-red light. The image on the fluorescent screen can be magnified by ordinary optical methods so that the unit magnification only is required for the electron optical system. Means are discussed for obtaining a distortionless and stigmatic electron image. The device may have applications for vision in fog and for viewing biological preparations. W. S. S.

See also Abstracts 3198, 3199, 3247, 3381, 3417, 3429, 3430 and 2407B. Kathode-Ray Oscillograph with After Acceleration. A. Bigalke.

ELECTROSTATICS.

3391. Recent Work on Voltaic E.M.F. O. Scarpa. *Ricerca Scientifica*, 9. *pp.* 10–13, *Jan.*, 1938.—Recent experimental work of Krüger and Schulz [see Abstract 3344 (1936)] is discussed critically, with the object of establishing definitely the real nature of voltaic e.m.f. The author emphasises the importance of the effect in physical and electrochemical theory, and is not prepared to accept their results as they stand. [See also Abstract 2516 (1938)]. D. R. H.

3392. Contact Potential Between Liquid and Solid Tin at the Melting Point. H. Kurzke and J. Rottgardt. *Zeits. f. Physik*, 109. 5–6. *pp.* 341–348, 1938.—From photoelectric saturation current curves, a value of approximately − 0·2 V between liquid and solid tin, is obtained at the melting point. This result corresponds to an increase of the same amount in the work of separation, on change over from the solid to the liquid state. D. R. H.

See also Abstract 3357.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

See Abstract 3404.

MAGNETISM AND ELECTROMAGNETISM.

3393. Periodic Orbits in the Equatorial Plane of a Magnetic Dipole. C. Graef and S. Kusaka. *J. Math. Phys.* 17. *pp.* 43–54, *March*, 1938.—An attempt is made to calculate the periodic orbits in the equatorial plane. It is shown that there is a bounded region of motion only for $\gamma \geqq 1$ (where 2γ is the axial component of the angular momentum of the particle at infinity) and that in the bounded region closed periodic orbits exist for a denumerable set of values of $\gamma > 1$, while for all other values of $\gamma > 1$ the motion is conditioned periodic. Several properties of the equatorial orbits are established and the asymptotic motions are investigated. N. M. B.

3394. Electromagnetic Field in Special Relativity. J. Roubaud-Valette. *Comptes Rendus*, 206. *pp.* 1457–1460, *May* 16, 1938.—The author obtains the well-known results of electromagnetic theory using a new notation of his own. G. C. McV.

3395. Paramagnetism of Electrons in a Rectangular Band. L. Néel. *Comptes Rendus*, 206. *pp.* 1471–1473, *May* 16, 1938.—Assumptions are made regarding the arrangement of the electrons in metals of the iron group which simplify the calculations of the magnetic properties of such metals. W. R. A.

3396. Time of Relaxation Due to Spin-Spin Interaction in Paramagnetic Crystals. R. de L. Kronig and C. J. Bouwkamp. *Physica*, 5. *pp.* 521–527, *June*, 1938. *In English.*—The time which the spins, giving rise to magnetisation, require to attain thermodynamic equilibrium when a strong external magnetic field suddenly alters is discussed theoretically. W. R. A.

3397. Theory of Magnetic Anisotropy of Cubic Crystals at Absolute Zero. W. F. van Peype. *Physica*, 5. *pp.* 465–482, *June*, 1938. *In German.*—A model is described which exhibits magnetic anisotropy and in which the energy used in magnetising the crystal to saturation is a symmetrical function of the direction cosine of the magnetising field and is characterised by an anisotropy constant K_1. For a simple cubic lattice, K_1 is positive at absolute zero, whilst for a body- or face-centred lattice it is negative ; with an increasing degree of degeneration, the sign does not alter but approaches zero. H. J. H. S.

3398. Generalisation of the Theory of Ferromagnetism. F. Bitter. *Phys. Rev.* 54. *pp.* 79–86, *July* 1, 1938.—The Weiss-Heisenberg theory of ferromagnetism is discussed and generalised in a plausible way. Whether this generalisation is theoretically sound must be determined by a quantum-mechanical investigation. The proposed equations of state, however, may be regarded as an attempt to describe antiferromagnetism (*i.e.*, the case in which oppositely directed spins on adjacent atoms have the lowest energy), pure metals having less than one spin per atom, and the magnetic properties of alloys. No attempt is made to compare the results with the properties of actual alloys, but it is shown that the proposed equations do give systems in which the Curie temperature depends on composition and atomic order ; in which nonmagnetic metals may combine to produce a ferromagnetic alloy ; in which wasp-waisted hysteresis loops occur ; and in which heat treatment may radically affect magnetic properties. Large effects are predicted which should make it easy to verify experimentally, whether or not the proposed approach to the problem is on the right track. AUTHOR.

3399. Magnetic Properties of Ferric Hydroxide. R. Chevallier and S. Mathieu. *Comptes Rendus,* 206. *pp.* 1469–1471, *May* 16, 1938.—The nature of ferric hydroxide formed depends on the conditions under which it is precipitated and particularly on the time of contact with the medium in which the precipitation is effected, the amount of washing, and the duration of drying. Variation of these conditions causes ferric hydroxides of different magnetic properties to be formed. All give the same ferric oxide on calcination. W. R. A.

3400. Moment of Cubic Single Crystals in a Magnetic Field. H. Mussmann and H. Schlechtweg. *Ann. d. Physik,* 32. 3. *pp.* 290–300, *June,* 1938.—Schlechtweg has previously discussed the problem of the limiting values of the moment of crystals for any crystallographic orientation in a magnetic field, as the field strength becomes infinitely great [see Abstract 913 (1937)]. A simpler treatment of the same problem is here given, which yields a convenient method for determining the crystallographic orientation of a circular single-crystal disc with respect to the magnetic field. Reference is made to the experimental results of Tarasov and Bitter [see Abstract 4702 (1937)]. A. W.

3401. Magnetic Susceptibility of the Iron in Ferrohæmoglobin. D. S. Taylor and C. D. Coryell. *Am. Chem. Soc., J.* 60. *pp.* 1177–1181, *May,* 1938.—The paramagnetic susceptibilities per formula weight of the iron in hæmoglobins of the cow, horse, sheep, and human are 12290, 12260, 12390 and 11910 $\times 10^{-6}$ c.g.s. units respectively at 25°. In an extensive study of cow hæmoglobin this quantity is found to be constant from an individual and to be unaffected by hæmolysis. The magnetic moment calculated for cow hæmoglobin (assuming independent Fe atoms) is $5{\cdot}435 \pm 0{\cdot}015$ Bohr magnetons; for horse, sheep and human hæmoglobin the moments are 5·43, 5·46, and 5·35 respectively. The presence in normal blood and in oxy-hæmoglobin solutions of hæmoglobin-like compounds which do not combine with O_2 has been noted. In these compounds the Fe is in the ferric state and an approximate value for its atomic paramagnetic susceptibility has been determined. The hæmoglobin concentration determined from the CO capacity after reduction agrees with that determined from the Fe content. Hæmoglobin concentrations can be determined magnetometrically with high precision. W. R. A.

3402. Atomic Moment of Tetravalent Rhenium. N. Perakis, T. Karantassis and L. Capatos. *Comptes Rendus,* 206. *pp.* 1369–1371, *May* 9, 1938.—From a thermomagnetic investigation of the hexachlororhenates of K and Cs and of the hexabromorhenate of K the moment of the tetravalent Re ion has been estimated as 18·95 Weiss and 3·83 Bohr magnetons. This agrees well with theoretically predicted values from consideration of electron spins. [See Abstract 875 (1936).]. **Errata,** *ibid., p.* 1767, *June* 8, 1938. W. R. A.

3403. Paramagnetic Dispersion with Different Orientations between H.F. and Constant Fields. P. Teunissen and C. J. Gorter. *Physica,* 5. *pp.* 486–488, *June,* 1938. *In English.*—The theory of paramagnetism in h.f. fields leads to the belief that if a constant field is applied perpendicularly, no such shift should occur. On the contrary, however, since in this case the susceptibility is determined by the nondiagonal matrix elements of the magnetic moment, and since the energy differences between the stationary states in general increase with increasing field, it is to be expected that the dispersion region will shift towards frequencies higher than 10°. The present research has verified this expectation and also investigated the dispersion if the angle ϕ between constant and h.f. field lies between 0° and 90°. H. H. Ho.

3404. Physical Basis of Some Metallurgical Problems. W. Gerlach. *Naturwiss.* 26. *pp.* 371–376, *June* 10, 1938.—A number of metallurgical problems which are attracting attention are briefly discussed under four headings: (*i*) the ferromagnetic properties of some solid solutions as a function of temperature; (*ii*) the effect of ferromagnetic properties on electrical resistance measurements of alloys; (*iii*) the para- and diamagnetic phenomena in certain alloys, and (*iv*) the electrical resistance of CuAl alloys at different temperatures. H. J. H. S.

***3405. Electromagnetic Method of Determining Induction-Coefficients of Magnetometer Magnets. J. H. Nelson.** *Terr. Mag.* 43. *pp.* 159–165, *June*, 1938.—The induction coefficient, $h = dM/M$ where M is the original magnetic moment and the induction factor μ ($=hM$) is constant over fairly long periods of time. The magnet to be tested has an electrically created field round it and is placed perpendicular to the suspended magnet of a Cooke magnetometer. The suspended magnet is unaffected by the electrical field. Tests show that h is nearly the same for increasing and decreasing fields over the range tested. Tables show the results of tests on magnets of tungsten and cobalt steel, and alnico. The value of μ is unaffected by the value of M. The advantages of the magnetometer method are given. R. S. R.

***3406. Magnetic Field Meter. R. H. Cole.** *Rev. S. i. Instruments*, 9. *pp.* 215–217, *July*, 1938.—An instrument similar in principle to one developed by Kohaut [see Abstract 4210 (1937)], but suitable for absolute measurements of large and inhomogeneous fields is described which consists essentially of a d.c. generator with a very small armature coil on the end of a long shaft driven by a synchronous motor, the induced voltage being a direct measure of the field. Typical results are given and the accuracy, relative and absolute, attainable discussed. AUTHOR.

See also Abstracts 3210, 3214, and
2419B. Magnetic Filings in Suspension. A. Guilbert.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***3407. Sharpness Index of X-Ray Intensifying Screens. H. Nitka.** *Phys. Zeits.* 39. *pp.* 436–439, *June* 1, 1938.—An Al step wedge having 20 stages each 0·5 mm. thick is bordered by two Pb strips and is radiographed at 40 kV and 150 cm. focus film distance, on films both with and without intensifying screens. The blackening characteristics of the films are examined by a photoelectric photometer having a slit width of 0·05 mm. From these measurements a "sharpness index" is derived for 9 different commercial types of X-ray intensifying screens. T. A. C.

3408. Radio-Kinematography. van de Maele. *Radiology*, 30. *pp.* 750–755, *June*, 1938.—There are two methods of radio-kinematography—the röntgenoscopic and the direct. In the first method the photographs of an image on a fluorescent screen are taken, for which cameras with objectives of special light gathering power are required. In the second method, the development of which is described in this paper, photographs are taken by means of the X-rays themselves after they have penetrated the portion of the body to be photographed. This method is particularly adapted for the photography of the details of smaller regions of the body, such as the gall bladder, the urinary system and the birenal region. It is necessary to use intensifying screens. The camera, which has been developed, is described in full detail. The relative advantages and future prospects of the two methods are also considered. G. G.

✱**3409. Construction of an Inexpensive X-Ray Kymograph. C. McNeill.** *Am. J. of Roentgenology & Radium Therapy*, 39. *pp.* 959–963, *June*, 1938.—The construction of an X-ray kymographic apparatus is described and illustrated, with examples of the radiographs obtained by its use. No claim is made for originality but the description is of an apparatus of very moderate cost, *i.e.*, 30 U.S.A. dollars. It is possible to synchronise the apparatus with an electrocardiograph. B. J. L.

3410. Million Volt X-Ray Protection. R. Dresser and B. J. Cosman. *Am. J. of Roentgenology and Radium Therapy*, 39. *pp.* 972–973, *June*, 1938.—In respect to a 1000 kV apparatus installed in the Huntington Memorial Hospital details of protective measurements carried out with an air-wall chamber ionoquantimeter are given. It is found that 5½ to 6 in. of lead absorb most of the direct radiation, but ½ in. of lead does not give complete protection, 1 ft. of cement being better. 1 ft. of cement plus ½ in. of lead is considered entirely safe. Scattered radiation from a commerical 200 kV constant potential apparatus is twice as great as the scattered radiation from the 1000 kV apparatus but sufficient protection of this comparative low voltage scattered radiation is given by a ¼ in. of lead. Systemic effects from h.v. X-rays are assumed to be less in respect to the operators than is the case with lower voltage X-rays. B. J. L.

3411. Calculation of Percentage Depth Doses. C. Packard. *Radiology*, 30. *pp.* 613–621, *May*, 1938.—A very large range of experimental work is surveyed with a view to obtaining simple numerical relationships between depth dose and focal distance, field area and quality of beam. Two nomograms are given :—(1) For calculating 10 cm. % depth doses under different portals when the dose for one portal is known, all other factors being fixed. (2) A similar nomogram for calculating 10 cm. depth depth doses for different focal distances. A chart is then given showing 10 cm. % depth doses for X-ray beams of different qualities with a port of 50 cm^2. and a focal distance of 40 cm. Starting therefore with a beam of known h.v.l. in Cu, it is possible by means of the chart and nomograms to calculate the % depth dose over a wide range of conditions. A number of examples illustrate the use of the method. For the determination of % dose at other depths, use is made of a series of curves which show the exponential relation between % depth dose and depth below 3 cm. If the 10 cm. depth dose is known the value for any other greater depth can be approximately calculated. J. E. R.

3412. X-Ray Distribution from Two Oblique Fields. M. C. Reinhard and F. Miers. *Radiology*, 30. *pp.* 633–635, *May*, 1938.—Ionisation measurements have been made in a water phantom which was irradiated simultaneously by two beams of X-rays. The separation of the inner margins of the two ports of entry of the beams was varied from zero to 4 cm. and the angles of incidence from 6° to 16°. The purpose of the experiments was to demonstrate the effect of random errors in set-up of X-ray tubes for the treatment of abdominal lesions. Isodose curves are given for a number of combinations of port separation and beam angulation. It is shown that small variations in the set-up for these "cross-fire" methods result in considerable changes in the distribution of radiation obtained. By careful arrangement of the ports and angles it is possible to obtain or avoid regions of high intensity where desired in a particular case. J. E. R.

3413. H.V. X-Ray Therapy in U.S.A. J. Belot and R. Collez. *J. de Radiologie et d'Électrologie*, **22.** *pp.* 257–269, *June*, **1938.**—A review of the state of 500–1000 kV X-ray therapy in U.S.A. in Sept., 1937. The advance is due to collaboration between radiologists and physicists, the former, demanding shorter wave-lengths for treatment and the latter higher energy particles for nuclear research. Tubes are in general of two types, the sealed-off cascade type of Coolidge and Bouwers or the continuously evacuated type of Lauritsen. Generators, originally of Greinacher, Villard or Wittka type are now (1) electrostatic, *e.g.*, van de Graaff or Herb compressed gaseous dielectric type, (2) r.f. Sloan-Exner or (3) the Lauritsen type of installation, of which several examples are given, some of these tubes having multiple ports so that three patients can be treated simultaneously. An account is given of the development of the sealed-off Coolidge cascade tube and of the new compact 600 kV unit. In regard to the results of the treatments, the authors are not of the impression, that there is any marked improvement, when the voltage is raised from 600 kV to 1000 kV, but that better results are obtained at 600 kV than at 200 kV. Concerning the possible extension of therapy using neutrons produced by a cyclotron, preliminary biological experiments show that neutrons are more effective than X-rays and show a greater selective action. For equivalent doses measured in *r* units neutrons are twice as effective as X-rays on drosophila eggs, 5 times on wheat seedlings, 4 times on a mouse, 5 times on mammary carcinoma and only 2·5 times on fern spores. The general impression is that the necessary apparatus is very expensive and must be confined to large centres where a physicist can collaborate with a radiologist. T. A. C.

3414. Effect of Neutron Irradiation on the Production of Mutations in Drosophila Melanogaster. N. W. Timoféeff-Ressovsky and K. G. Zimmer. *Naturwiss.* 26. *pp.* 362–365, *May* 27, 1938. Previous work had shown that the production of sex-linked mutations in *Drosophila melanogaster* by equivalent doses of X-rays, Grenz-, β- and γ-rays is directly proportional to the dose in röntgens and shows no dependence on the quality of the radiation. In these experiments fast Li + D neutrons from a 300 kV generator [see Abstract 980 (1937)] with the intensity measured in equivalent röntgens by condenser ionisation chambers of "Aerion," are shown to be less effective than an equivalent dose of X-rays. The results show that the densely ionising track of the recoil proton produces a weaker mutation effect than the less densely ionising radiation. T. A. C.

See also Abstract 3215.

OSCILLATIONS AND WAVES.

3415. Relaxation Oscillator with Double-Grid Valve. H. Morin.** *Comptes Rendus*, 206. *pp.* 1560–1562, *May* 23, 1938.—The filament of a Philips A 441N valve is fed from 4V through a resistance of 15Ω, the anode voltage being 44V. The interior grid is connected through a non-inductive resistance of 40000Ω to the anode battery and through a capacity C and non-inductive resistance R, in series, to the negative terminal of the filament battery. The exterior grid is connected to the common point of C and R and a non-inductive resistance of 10000Ω is inserted in the anode lead. With this arrangement stable oscillations are obtained for values of the filament current between 50 and 65 mA. Various forms of oscillation were obtained with different operating conditions and their characteristics were investigated with a Dubois oscillograph. **Erratum,** ***ibid. p. **1768,** ***June*** **8, 1938.** A. W.

✱**3416. Oscillator for Ultra-High Frequencies. W. L. Barrow.** *Rev. Sci. Instruments*, 9. *pp.* 170–174, *June*, 1938.—A coaxial line stabilised oscillator that is easily and rapidly adjustable over the frequency range from 70 to 700 Mc./sec. is described. Rugged mechanical construction, substantially complete shielding and coaxial line output connection are other features. With a 316A type valve, outputs of several watts are obtained over the entire range. Measurements indicate that for best stability it is necessary to tune precisely both filament leads, in addition to providing a high Q tank circuit. An optimum resonant length ($\lambda/4$, $3\lambda/4$, . . .) of line was not found. The stability decreases as the frequency increases, becoming very poor for frequencies near the limit of oscillation of the tube. AUTHOR.

✱**3417. Circuits Producing Sharp Electrical Impulses Free from Curvature and Their Use in Oscillographic Work. J. C. Morgan.** *Rev. Sci. Instruments*, 9. *pp.* 183–186, *June*, 1938.—A device is described for producing very sharply peaked electrical impulses devoid of the curvature at the base so characteristic of condenser discharges and peaked wave forms. The sharp impulse is applied to the grid of a greatly over-biased valve, thus only the peak of the impulse is represented by the plate current output. The advantages of such peaks in oscillograph and stroboscope work are outlined. They enable a single oscillograph element to record at least three independent quantities. The paper concludes with a note on irregularities in some frequency sources. AUTHOR.

3418. Velocity of Propagation of Electric Waves along Thin Metal Wires and the Permeability of Iron for Hertzian Oscillations. K. F. Lindman. *Zeits. f. techn. Physik*, 19. 6. *pp.* 158–163, 1938.—By measurement of the wave-length λ of electric oscillations, of different frequencies, used to produce standing waves along two thin parallel metal wires and comparing the values of λ with their normal values λ_0 (for thick Cu wires or in air) it is found that the velocity of propagation of the electric force along sufficiently thin wires is appreciably smaller than that of light, the difference depending on the cross-section of the wire, the wire material and the normal wave-length λ_0 in a manner which is in good agreement with the theory developed by Sommerfeld and based on Maxwell's equations. In some of the experiments carried out harmonics were observed whose propagation velocity along thin wires was somewhat greater than that of the fundamental. When electric waves along a large diameter wire pass to a very thin wire, or vice versa, they are partly reflected at the change-over point, in the former case with zero phase change and in the latter case with a phase change of π. Since the Sommerfeld formula for the difference $\lambda_0-\lambda$ contains the magnetic permeability (μ) of the material of the wire, it is possible, from the observed values of $\lambda_0-\lambda$ for iron wires, to calculate the permeability of iron for different wave-lengths. In this way it is found that when λ_0 increases from the smallest wave-length used (15·8 cm.), μ increases from the value 10·6 at first very rapidly, reaching at about λ_0 = 48 cm. a value of 100 and subsequently increasing only very slowly. A. W.

3419. Ionisation of F-Region Before Sunrise. K. B. Mathur. *Nat. Acad. Sci. India, Proc.* 7. *pp.* 222–226, *Dec.*, 1937.—Curves have been drawn for the time of sunrise and sunset at different heights for Allahabad for the whole year and with the help of these curves, the height where the sun's rays are falling at the time of minimum ionisation of the F-region just before sunrise is found. Similar calculations have been made for Washington and Slough and from these it has been shown that this height is greater in winter and smaller in summer for all the latitudes. For higher latitudes (*e.g.*, Slough) the ionisation always begins to rise after sunrise in the F-region while for lower latitudes (*e.g.*, Washington and Allahabad) it can be roughly said that the ionisation begins to rise before sunrise in winter and after sunrise in summer. AUTHOR.

3420. Non-Seasonal Change of F_2-Region Ion-Density. L. V. Berkner and H. W. Wells. *Terr. Mag.* 43. *pp.* 15–36, *March*, 1938.—Detailed analysis is made of noon observations of F_2-region ion-density at Washington and at Watheroo, Australia, for 1935–37. The data contain a variation component which is in the same phase at both stations and has a principal period of one year. Its amplitude is about equal to that of the seasonal variation. Sunspot activity, inhomogeneity of data, analysis method and the heating ratio for the two stations are investigated and discarded as explanations of the non-seasonal change. Available data from other stations indicate a similar result. The cause is thought to be associated with the earth or its motion. [See Abstract 4905 (1936).] R. M.

See also Abstract 3426, and

2523B. Propagation of Electromagnetic Waves over a Conducting Sphere. B. van der Pol and H. Bremmer.

2525B. Abnormal Phenomenon in Short-Wave Transmission. D. Arakawa.

PHOTOELECTRICITY.

3421. Photoelectric Properties of Evaporated Bismuth Films. A. H. Weber. *Phys. Rev.* 53. *pp.* 895–899, *June* 1, 1938.—Some photoelectric properties of Bi films deposited on glass by evaporation in high vacuum are investigated. It is shown that the photoelectric emission and threshold wave-length increase with film thickness to a limiting value. DuBridge's method, in which the photoelectric currents are measured at a single incident frequency and variable temperature, was employed in the threshold determinations and an excellent fit of the observed data to the theoretical curves is always obtained for the temperature range $-53 \cdot 8°$ C. to $24 \cdot 4°$ C. but not for higher temperatures. The maximum threshold wave-length for the Bi films as determined by the present work is between 2564 and 2600 Å. The minimum measured threshold wave-length, corresponding to a glass surface thinly spattered with bismuth, is between 2443 and 2506 Å. Films subject to possible gas contamination and films more carefully protected from such contamination show little difference. Two sets of data, analysed by Cashman's method, give values of n, the exponent of T in the photoelectric emission equation equal to $2 \cdot 039$ and $2 \cdot 052$. AUTHOR.

3422. New Phenomenon in Photo-Cells at High Frequencies. P. Grivet. *Comptes Rendus*, 206. *pp.* 1798–1801, *June* 13, 1938.—A vacuum cæsium cell receives light modulated at $13 \cdot 5$ Mc./sec., and the fundamental of the alternating component of the current produced is studied. The variation of this current with the accelerating voltage is very different from the corresponding variation when continuous illumination is employed. The curve shows a sharp maximum, and the phase of the current changes rapidly in the region of this maximum. The cell had a spherical kathode and fine wire anode, which could collect only a fraction of the emitted electrons. The phenomenon is explained by the effects of those electrons which are not collected by the anode but return to the kathode. Such electrons have no effect on the measurements made with continuous illumination, but with modulated illumination fluctuations in the number emitted gives rise to a component of current in the external circuit. Mathematical treatment of this idea yields curves which are in approximate agreement with those obtained experimentally. L. H.

***3423. Properties of Emission Photo-Cell of New Design. G. A. Boutry and J. Gillod.** *Comptes Rendus*, **206**. *pp.* 1807–1809, *June* 13, 1938.—Experiments on a new design of emission photo-cell [see Abstract 1392 (1937)] are described, and they confirm that the cell has the properties claimed for it, namely, exact proportionality between current and light intensity, saturation at a very low voltage and a very small dark current. D. H. F.

3424. Compound Photokathodes. P. Görlich. *Zeits. f. Physik*, **109**. 5–6. *pp.* 374–386, 1938.—Kathodes of the type [Ag]-Cs$_2$O, Cs, Ag-Cs are provided with transparent layers of the type [Bi, Cs]-Cs or [Sb, Cs]-Cs. Investigations of the spectral distribution of the photoelectric effect indicate the presence of photoelectrons derived from the layers below the surface. The mechanism of emission is discussed and it is pointed out that the use of compound kathodes may make it possible to arrive at any desired spectral distribution of photoelectric sensitivity, *e.g.*, that corresponding to the eye. L. A. W.

3425. Selenium Photo-Cells. H. Schweickert. *Zeits. f. Physik*, **109**. 5–6. *pp.* 413–430, 1938.—Resistance and capacity measurements on Se photo-cells indicate the presence of a blocking layer, the properties of which determine the performance of the cells. Contrary to the assumption of other workers, the resistance of the blocking layer does not depend upon the illumination, and this makes it possible to determine the energy distribution of the photoelectrons entering the cover electrode. Measurements of the spectral distribution for intermittent illumination and different voltages do not confirm the findings of Liandrat (*Thesis, Paris*, 1935). In the short-circuit current the quantum yield exceeds 0·5 but is less than unity. Even small quantities of Hg vapour are found to reduce the sensitivity of the cells, presumably by affecting the blocking layer. L. A. W.

See also Abstract 3362.

THERMIONICS.

3426. Background Noises and Valve Amplifiers. M. Mandò. *Ricerca Scientifica*, **9**. *pp.* 217–234, *March*, 1938.—Theoretical discussion of the experimental results hitherto obtained on the background noises in valve amplifiers. The dependence of the Schottky and Johnson effects on resistance and capacity is examined; it is concluded that the former effect can be reduced only by consideration of each individual circuit but that the latter is capable of a more general treatment. F. C. C.

3427. "Three-Halves Power" Law of Thermionic Emission. E. L. E. Wheatcroft. *Leeds Philosoph. and Lit. Soc., Proc.* **3**. *pp.* 498–499, *April*, 1938.—A simple dimensional analysis is used to show that the scope of the 3/2 power law is not limited to the idealised conditions of the Child-Langmuir equations. It is also shown that, to a first approximation, the formula for the thermionic current for a cylinder is the same as that for parallel plates, provided the current density is reckoned in terms of the anode area. H. J. H. S.

3428. Emission of Protons from Hydrogenated Palladium. T. Franzini. *N. Cimento,* 15. *pp.* 88–99, *Feb.,* 1938.—An extensive investigation has been made of (*a*) the thermo-electronic emission of pure Pd, (*b*) the thermo-electronic emission of hydrogenated Pd, (*c*) the thermo-protonic emission of hydrogenated Pd, and (*d*) the passage of H_2 through Pd. Equations are given connecting the emission and temperature, and the rate of passage of H_2 as a function of temperature. The expressions derived for (*b*) and (*c*) are not valid for high temperatures, *i.e.*, 1300° K. and 1000° K. respectively. The departure from the formulæ is attributed to recombination of electrons and protons. C. J. B. C.

3429. Further Observations with the Field Electron Microscope. E. W. Müller. *Zeits. f. Physik,* 108. 9–10. *pp.* 668–680, 1938.—A low-voltage electron microscope employing a point kathode [see Abstract 5129 (1937)] is used for examining the effect of a layer of Ba on the emission of pure W. The longitudinal magnification of this arrangement of the electron microscope may be as much as 10^6 (corresponding to a resolving power of 10 Å), and it is possible to observe the emission behaviour of individual ions; a number of photographs are given in illustration. A comprehensive account is given of the emission behaviour of Ba-on-W layers as obtained by this method. H. J. H. S.

3430. Field Emission of Electrons at Thin Films of Insulating Material of the Type Al-Al_2O_3 - Cs_2O. J. Mühlenpfordt. *Zeits. f. Physik,* 108. 11–12. *pp.* 698–713, 1938.—A description and diagrams are given of the production of a field kathode and the vacuum technique necessary to alter the pressure and introduce various gases. The kathode is cylindrical and it is shown that the discharge can be produced by bombardment with both quick electrons and positive gaseous ions. When inert gases are introduced and the potential lowered, the decaying Malter effect changes to spray discharge [see Abstract 4641 (1937)], and the process is reversed by pumping off the gas. Two types of spray discharge are noted of different colours, the one at higher potential showing sparking at the kathode. Graphs of voltage, pressure and current are given. The decay velocity of the Malter current is accelerated by raising the temperature, the emission being retarded. The layer, deactivated by O_2 drawing Cs_2O to the surface, is reactivated by electron bombardment producing metallic Cs. H. M. B.

3431. Evaporation of Atoms, Ions and Electrons from Tungsten. A. L. Reimann. *Phil. Mag.* 25. *pp.* 834–848, *June,* 1938. *Supplement.*—Careful measurements were made of the evaporation of electrons, atoms and positive ions from tungsten filaments and the results obtained are compared with those of Moon and of Wahlin and Whitney. For both evaporation and electron emission there is close agreement with the results of Wahlin and Whitney, showing that over a very considerable temperature range there is a correspondingly close agreement in the temperature scales employed. The results for positive ion emission, as with Moon's and Wahlin and Whitney's results, are all considerably below the theoretical values. It appears that the present theory of positive ion emission is too simple and that there must be some variable surface condition that should be taken account of, which, while not affecting appreciably either electron emission or evaporation, does nevertheless have an important effect on the emission of ions. A. W.

See also Abstract 3307.